A Housing Energy Management Program Report

Energy
Ontario

42

IMPROVING THE PERFORMANCE OF RESIDENTIAL HEATING & DISTRIBUTION SYSTEMS IN EXISTING HOUSES

(PHASE I)

Undertaken jointly by the Ontario Ministries of Municipal Affairs and Housing and Energy under the Housing Energy Management Program (H.E.M.P.)

Prepared for
Ontario Ministry of Municipal Affairs and Housing
Technical Services Division
Research and Development Section

by

The Heating, Refrigerating & Air Conditioning Institute of Canada
(H.R.A.I.)

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INTRODUCTION

The Heating Refrigerating And Air Conditioning Institute (H.R.A.I.), a national trade association for these industries, was commissioned by the Ontario Ministry Of Municipal Affairs And Housing, Research And Development Section, with funds provided by the Ministry Of Energy under the Housing Energy Management Program (HEMP), to undertake the development and testing of a program to reduce the energy consumption of existing houses, with air systems, by improving the performance of their heating and distribution systems.

The program objectives were as follows:

(1) Develop a heating system services check list for homeowners.
(2) Implement a maintenance package (tune-up) for each home.
(3) Improve the comfort level in each house.
(4) Test each fossil fuel heated house for sufficient combustion air.
(5) Ascertain the energy savings.
(6) Develop a retrofit package for each house.

A detailed description of the project appears in the appendix.

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PART A

BACKGROUND

The Ministry of Municipal Affairs And Housing, with the assistance of the Building Department of the Town of Vaughan, selected twenty houses for this project. Nine were heated with oil, seven with natural gas, three with electric furnaces and one had a combination oil/heat pump system. Most of the houses were from twenty to forty years old.

The owners of these homes were invited to a meeting, during which the details of the program were outlined and their co-operation enlisted. A free heating system tune-up together with a retrofit assessment was offered to the building owners. They in turn were required to provide records of energy consumption for the period before and after the tune-up and promise not to undertake any large energy measures for one year.

The tune-ups, for purposes of this program, were to be more comprehensive than those normally carried out. They included an in-depth analysis of the heating system and the envelope, in order to ascertain the condition of existing systems. Several additional tests were conducted both before and after the tune-ups, in order for us to determine the immediate affects of the work done.

To best utilize the skills of the service technicians who carry out the actual tune-ups, two check lists were developed. The first, to be used by the project manager

during an initial visit to the home. This was used to gather relevant information on the occupant's living habits, the house envelope, comfort complaints and other information that would assist the service technician when he arrived to conduct the actual tune-up.

The second check list is for the service mechanic and consists of three check lists; one for gas, one for oil and one for electric systems. These were prepared by the project manager, W. D. Geddes, and a team of knowledgeable contractors selected from H.R.A.I.'s membership.

The tune-ups took a total system approach. The furnace, distribution and control parts were considered as an integral system. Since these tune-up check lists were developed for eventual use in the open market, they listed most items that could be undertaken to reduce energy consumption in a given short period. The distribution system could not be ignored since some of the major total system efficiency improvements came from the distribution system tune-up rather than combustion efficiency improvements. It was also noted that the distribution system, because of design defects, could not deliver the improved furnace combustion efficiencies to the house, or at least the parts of the house where it was most needed. Wherever plastic deflectors were found so were homeowner complaints about drafts. In every case, the owner agreed that the removal of the deflectors eliminated the drafts.

FINDINGS

The tune-ups increased the combustion efficiency of the gas furnaces by an average of 3% and oil furnaces by an average of 10%, (See Table 1).

Net stack temperatures reduced by 4% on average, with the gas furnaces and 6% with the oil furnaces, (See Table 2).

The volume of air delivered by the distribution system increased an average of 10% and the kwh. of heat delivered by the distribution system increased by an average of 14% because of the tune-ups, (See Table 3). On average, 39% of the furnace output was being delivered by the distribution system prior to the tune-up and 41% after a 4% improvement. None of these figures indicate any very significant changes resulting from the tune-ups, but they are deceiving. Tuning up both the furnace and the distribution system together had a multiplier effect. The average kwh. delivered by the supply outlets increased over 14% because of the tune-ups. That is a very significant increase and should be reflected in lower energy consumptions. An additional unknown factor that may or may not show up in reduced energy, is the air balancing done to solve occupant comfort complaints. Hopefully, lower thermostat settings will be possible, with a more even distribution of heat throughout the house. In fact, this balancing may reduce delivery efficiency of the total system because of the restrictions to airflow caused by partially closed dampers.

TABLE I

COMBUSTION EFFICIENCY CHANGES

GAS

HOUSE #	PRE-TUNE-UP EFFICIENCY	AFTER TUNE-UP EFFICIENCY	% CHANGE
5	75.7%	78.5%	+4%
7	76%	77%	+1%
8	72.3%	79.4%	+10%
11	76%	77.6%	+2%
12	74.3%	76%	+2%
13	77.5%	77.5%	-
20	77.5%	77.5%	-
Average	75.6%	77.6%	+3%

OIL

HOUSE #	PRE-TUNE-UP EFFICIENCY	AFTER TUNE-UP EFFICIENCY	% CHANGE
1	74%	77%	+4%
2	55%	73%	+33%
9	69.6%	74.5%	+7%
14	76%	76%	-
15	68.1%	74.3%	+9%
16	72%	76%	+6%
17	60%	73.8%	+23%
18	75.7%	77.4%	+2%
19	78.4%	81%	+3%
Average	70%	76%	+10%

TABLE 2

NET STACK TEMPERATURE CHANGES

GAS

HOUSE #	PRE-TUNE-UP TEMP °C	AFTER TUNE-UP TEMP. °C	% CHANGE
5	124.4°C	132.2°C	+6%
7	160°C	143°C	-11%
8	115.6°C	110°C	-5%
11	151.1°C	140.6°C	-7%
12	135.6°C	126.7°C	-7%
13	165.6°C	165.6°C	-
20	150.4°C	149.3°C	-1%
Average			-4%

OIL

HOUSE #	PRE-TUNE-UP TEMP °C	AFTER TUNE-UP TEMP. °C	% CHANGE
1	285.6°C	267.2°C	-6%
2	199°C	190°C	-5%
9	283.3°C	253.3°C	-11%
14	278°C	278°C	-
15	303.9°C	300°C	-1%
16	332.2°C	310°C	-7%
17	299°C	284°C	-5%
18	310°C	297.8°C	-4%
19	245°C	210.6°C	-14%
Average			-6%

TABLE 3

DISTRIBUTION SYSTEM CHANGES

HOUSE #	DELIVERED * AIR VOLUME BEFORE TUNE-UP	DELIVERED * AIR VOLUME AFTER TUNE-UP	% CHANGE	DELIVERED KWH BEFORE TUNE-UP	DELIVERED KWH AFTER TUNE-UP	% CHANG
1	19.4	21.5	+11%	10.3	11.0	+7%
2	14.5	15.8	+9%	8.6	8.7	+1%
3	6.4	9.7	+52%	1.5	2.5	+67%
4	13.1	13.1	-	5.8	5.8	-
5	11.9	12.2	+3%	7.0	8.3	+19%
6	16.9	20.5	+21%	9.0	9.5	+6%
7	18.1	23.7	+31%	13.9	15.5	+12%
8	15.9	16.9	+6%	10.6	10.9	+3%
9	8.7	8.9	+2%	6.3	6.2	-2%
10	14.3	17.0	+19%	7.4	11.3	53%
11	16.8	18.7	+11%	10.1	11.9	+18%
12	15.0	16.5	+10%	11.0	11.2	+2%
13	30.3	30.3	-	18.9	16.6	-12%
14	15.2	16.9	+11%	10.5	11.8	+12%
15	5.6	5.2	-7%	9.8	9.7	-1%
16	17.5	19.0	+9%	9.8	10.5	+7%
17	10.8	12.0	+11%	5.5	8.5	+55%
18	14.0	15.3	+9%	7.1	9.6	+35%
19	8.2	8.3	+1%	5.7	5.7	-
20	11.4	11.4	-	2.8	2.8	-
Average			+10%			+14%

*Cubic meters per minute.

TUNE-UP RESULTS

The tune-ups resulted in substantial immediate improvements in most houses.

DISTRIBUTION SYSTEM

In many cases, a substantial amount of the heat output of the furnace could not be delivered by the distribution system to the appropriate rooms in the house. Considerable improvements in heat delivery were possible in cases where the causes were: leaky duct fittings; slipping fan belts; fan speed set too low; dampers shut in error; restrictions in outlets; or by-pass humidifier dampers set too far open. Houses with any of these problems will benefit from the tune-ups, though a finished basement ceiling will reduce the ability to solve some. If a house has one or more of these problems, the program indicated that the delivery efficiency of the heating system can be increased by 20 to 50%.

THERMOSTATS

Anticipators were sometimes found to be incorrectly set, causing continuous short cycling of the furnace. This is not only hard on the equipment, but can substantially reduce seasonal efficiency.

HEATING APPLIANCE

Electric furnaces benefit from the tune-up if they have defective parts such as sequencers and relays repaired.

The actual repair cost would be over and above the normal tune-up cost. Most gas furnaces showed some combustion efficiency improvements regardless of their age. Gas furnaces that are only 2 or 3 years old and properly installed, will not benefit substantially from the tune-up. However, the occupants of all homes with gas heating would benefit from the safety inspection that accompanies the tune-up.

Oil furnaces showed the greatest improvements. Older furnaces benefited the most, but even the newer units required the tune-up to bring them to their optimum efficiency.

HUMIDIFIERS

Most of the bypass humidifiers had their damper adjusted to allow the full flow of air to pass through the humidifier's 6" duct. This can cause considerable short circuiting of distribution system air (100 - 150 cfm), which in some cases severely reduced the delivery capabilities of an already inefficient system. In these cases, the dampers were partially closed.

MONITORING AND DATA COLLECTION

For the electric and gas heated homes, the service technician read and recorded the meter after the tune-up. These meters were read again after two or three weeks. Oil furnaces had oil flow meters attached during the tune-up. Their readings

were recorded at that time and again two or three weeks later, when the meters were removed.

Longer term monitoring will be conducted through the receipt of the next heating season's energy bills during Phase 2. This will provide a more accurate indication of the success of the tune-up in reducing energy consumption.

A degree day formula was applied to the heating bills covering the two heating seasons prior to the tune-up, to determine the amount of energy consumed to heat the house for one degree day. The same formula was applied to the amount of energy consumed after the tune-up, during the brief two to three week monitoring period, to ascertain whether or not less energy was now being consumed per degree day, as a result of the tune-up. Since the tune-ups were done during March, April and May, the fossil fueled heating systems were being monitored during their most inefficient time. (Short cycles)

ENERGY SAVINGS

The short term monitoring indicated that the average gas furnace consumed 24%* less fuel after the tune-up. The average oil furnace reduction in consumption was 18%*. The average electrical consumption for heating was reduced by 30%.

ENERGY CONSUMPTION CHANGES RESULTING FROM TUNE-UPS

	HOUSE	FUEL CONSUMPTION CHANGE AFTER TUNE-UP
ELECTRICAL	3	NA
	4	-7.5%
	6	-54%
	10	-28%
	Average	30% Savings
GAS	5	-78%*
	7	+.4%
	8	-23.5
	11	-6%
	12	-49%
	13	-40%
	20	NA
	Average	-24% Savings
OIL	1	+12.7%
	2	-76%*
	9	NA
	14	-7.5%
	15	NA
	16	NA
	17	NA
	18	-52%
	19	-21%
	Average	-18% Savings

*These numbers were not included in the average as they may not be reliable. Further monitoring in Phase II will clarify these results. (NA) indicates that this information is not available.

COMBUSTION AIR TEST RESULTS

Each house with a fossil fuel furnace, was tested for sufficient combustion air. This test was done while all exhaust fans, clothes dryers, and fireplaces (if operable) were in operation. The flue was then checked with the flue gas analyzer to ensure that there was a negative draft, indicating that the combustion gases were going up the chimney.

All of the houses appeared to have sufficient combustion air. This was not surprising, because a visual inspection of most of the houses found many cracks for air to enter, especially in the basement. In other words, none of the oil or gas heated houses appeared to be well sealed.

RETROFIT OPTIONS

The last stage of this project involved the development of retrofit options for those homes that could benefit from some kind of more substantial changes to their heating systems. Some of the houses offered no opportunity for any kind of practical or cost effective additional changes. Other houses would benefit from major changes and considerable capital outlay, with a good return on investment.

In those houses where the occupant does not now manually set back the thermostat at night or during regular absences and the occupants habits and personality might be condusive to set-backs, the addition of an automatic set-back thermostat was suggested. If the occupants already manually set back the

thermostat, we did not suggest a set-back thermostat because there would be no savings and possibly a slight increase in consumption. In one house, some of the ducts ran through an unheated crawl space and the rooms they fed were cool. In that case, insulation of those ducts would be the most cost effective retrofit activity. Another house had four-inch branch runs throughout and no dampers. Installation of a few 5" or 6" runs would provide more comfort and distribution system efficiency.

Houses that were heated with oil, offered the greatest opportunity for further system improvements. If the oil furnace appeared to be in good condition, we suggested the addition of either an electric plenum heater or a gas conversion burner. In every case, the gas conversion burner appeared to have the faster pay-back. If the oil furnace was older, or in poor condition, we suggested a complete new furnace, in most cases gas (providing the occupant had no dislike for gas). Gas was selected because most of the houses had a 60 amp., or at the most 100 amp. service, which will necessitate a service upgrade at a high cost. Whenever gas was considered as a retrofit, the savings and pay-back of the three types of gas furnaces were outlined. For purposes of this study, the regular gas furnace was assumed to have an average seasonal efficiency of 60%, the medium efficiency gas furnaces (with forced draft) a 75% seasonal efficiency and the condensing type furnaces a 90% seasonal efficiency.

Surprisingly, the medium efficiency gas furnace had the shortest pay-back period. The condensing gas furnace would

have had a faster pay-back, except that it used so little gas, that the unit cost of gas fell into the higher rate structure of the gas company. If it were not for this pricing policy, the condensing furnace would have shown quicker pay-back times. However, pay-back is a short term view. Once an item is paid for, what is more important is the year after year savings. The alternative with the longest pay-back period, may provide the greatest savings over the life of the equipment.

When calculating pay-back, for simplicity, we used today's energy costs. In the reality of fast rising energy prices, pay-back periods and annual savings could be better than indicated.

TABLE 4

RETROFIT POSSIBILITIES AND THE PAYBACK PERIOD IN YEARS

HOUSE #	PLENUM HEATER	CONVERSION GAS BURNER	CONVENTIONAL GAS FURNACE	MEDIUM EFFICIENCY GAS FURNACE	HIGH EFFICIENCY GAS FURNACE	DUCT WORK	DUCT INSUL.	COMBUSTION AIR	SET BACK THERMOSTAT
1	7 yrs.	3.4 yrs.	-	-	-	-	P/B	-	-
2	-	-	-	4 - 5 yrs.	-	-	-	-	-
3	-	-	-	-	-	P/B	-	-	-
4	No retrofits recommended								
5	-	-	-	-	-	P/B	-	-	-
6	No retrofits recommended								
7	No retrofits recommended								
8	No retrofits recommended								
9	-	-	7.2 yrs.	5.4 yrs.	6.2 yrs.	P/B	-	-	P/B
10	-	-	-	-	-	-	-	-	P/B
11	-	-	-	-	-	P/B	-	-	-
12	-	-	-	-	-	-	-	P/B	-
13	No retrofits recommended								
14	9.9 yrs.	-	6.3 yrs.	5.1 yrs.	6.3 yrs.	-	-	-	-
15	-	-	3 yrs.*	-	-	-	-	-	-
16	6.8 yrs.	-	-	-	-	P/B	-	-	-
17	-	-	4.4 yrs.	3.6 yrs.	4.1 yrs.	-	-	-	-
18	3.6yrs.	1.5 yrs.	-	-	-	-	-	-	-
19	16.4yrs.	-	-	-	-	P/B	-	-	3.3 yrs.
20	No retrofits recommended								
Total	5	2	4	4	3	6	1	1	3

P/B? - Indicates recommended option, pay-back period unknown.
* Owners own gas furnace would be installed.

Recommended options are underlined

REVIEW OF CHECK LISTS

After all the tune-ups were completed, the check lists were reviewed. The experience of this demonstration allowed us to improve on the checklist and develop one that would be used in the open market place. Several very experienced and knowledgeable contractors also reviewed the lists and offered some very good suggestions. The industry seems to be very pleased with this check list (attached, see appendix) because it is thorough, well sequenced and practical. The contractors that reviewed the list, did comment, that in order to put this program in place, an instruction book detailing the use and application of the check lists would have to be developed. This together with the information gathered could be presented to the industry in a series of seminars produced for the contractor's service personnel.

TUNE-UP TEST EQUIPMENT

To carry out the required tune-ups accurately and in a reasonable time, the technician must have an electronic flue gas analyzer. The application of other instruments are too inconsistant and often no two people will get the same readings with the mechanical analyzers.

TUNE-UP PAY-BACK PERIOD

The tune-ups appeared to provide significant reductions in the energy consumed for heating. Though it has to be

confirmed by a broader sampling, it looks as if the tune-ups could be offered by a contractor for the following prices and should be done at the indicated intervals:

Electric	$50	Every 5 years
Gas	$75	Every 3 years
Oil	$95	Every 2 years

The pay-back period for the tune-ups, based on these market prices will vary considerably, depending upon how poor the heating system is prior to the tune-up. Indications are that pay-backs will range between one to nine months on electrical systems, four to six months on gas and two to twenty months on oil.

Next year's fuel bills will give us much more accurate pay-back times. However, these preliminary figures indicate that the suggested charge-out rates for the tune-ups would produce a pay-back period that is much shorter than the suggested tune-up intervals. This should make the program highly marketable to homeowners, without any government financial assistance.

PART B

INDIVIDUAL HOUSE

TUNE-UP EVALUATIONS

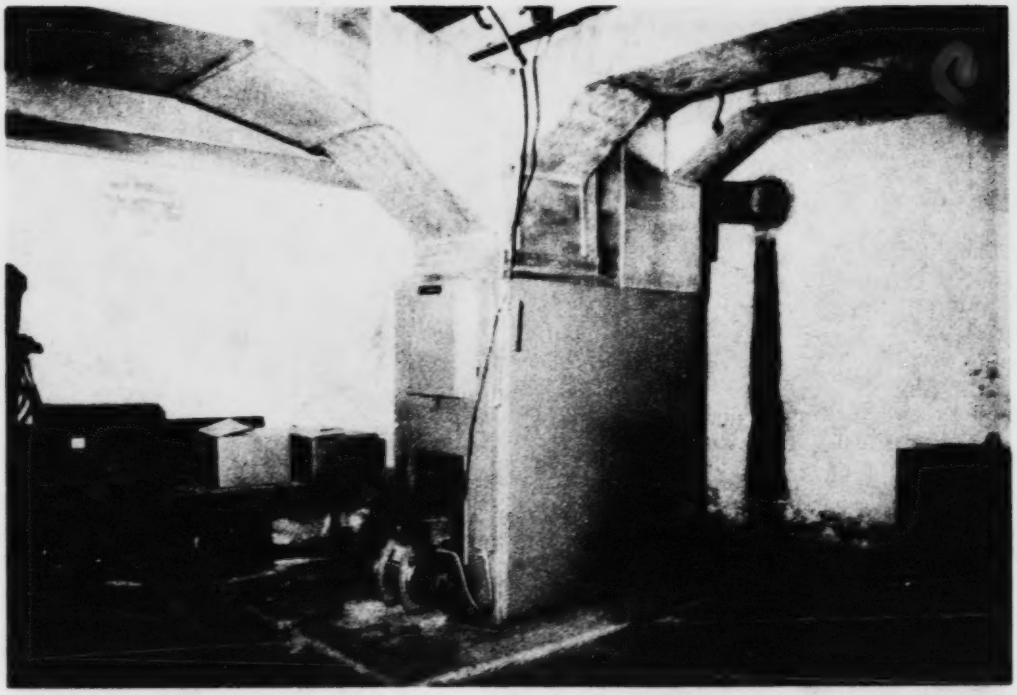
AND

POTENTIAL FURTHER

SYSTEM IMPROVEMENTS

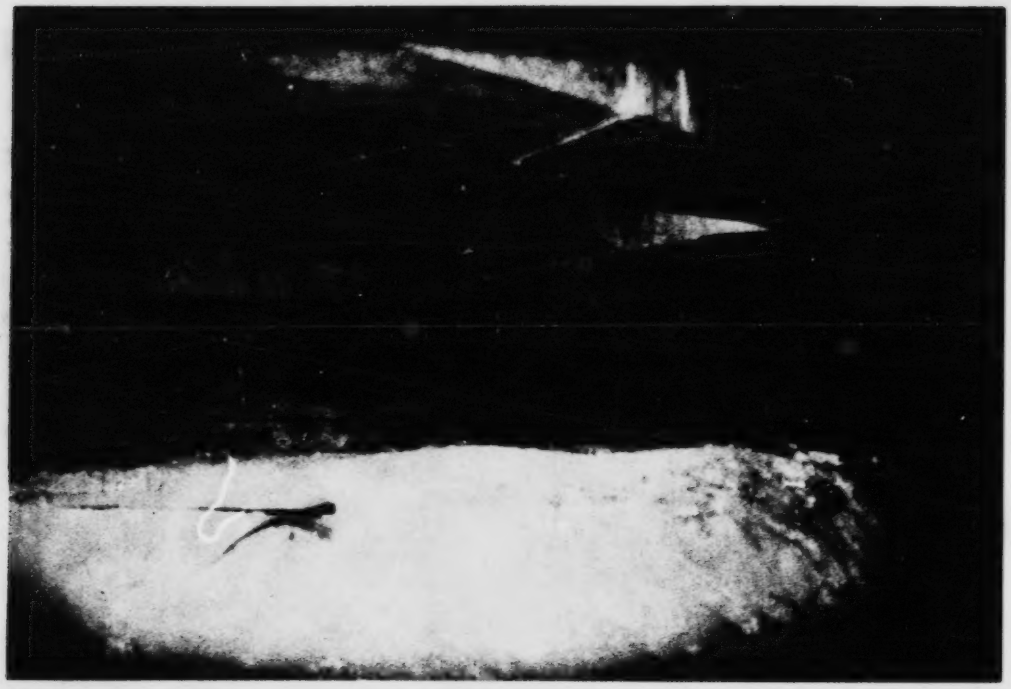
HOUSE #1

Thirty Year Old Woodbridge House

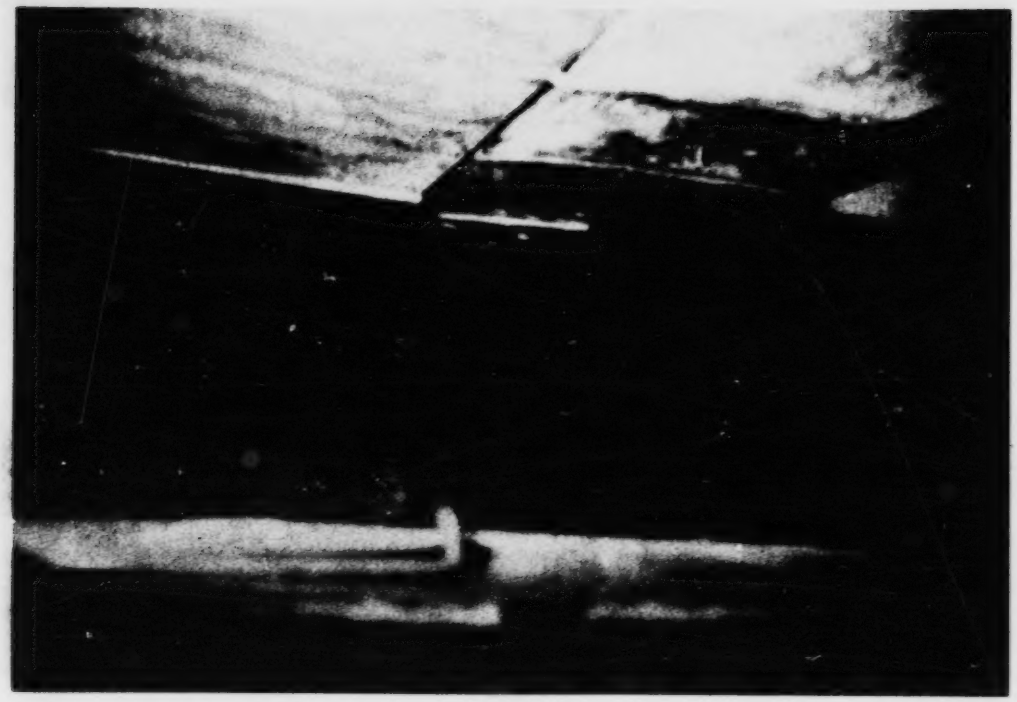


Four Year Old Forced Air Oil Furnace

HOUSE #1

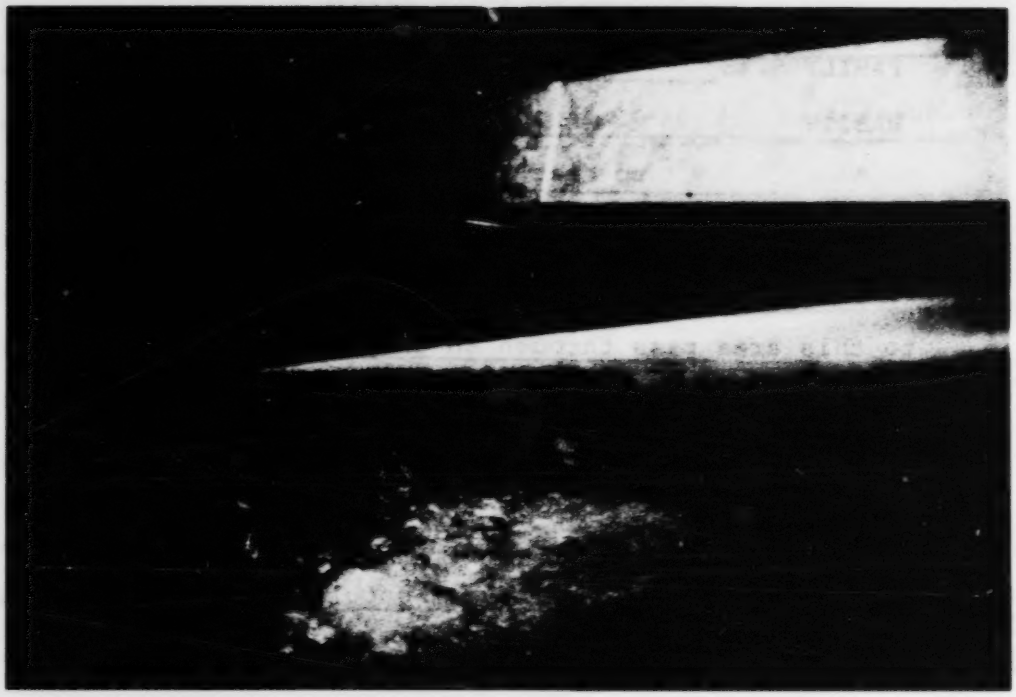


Ducts In Unheated Crawl Space



Ducts In Unheated Crawl Space

HOUSE #1



Ducts In Unheated Crawl Space

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 1 ADDRESS Woodbridge

BUILDING DESCRIPTION - TYPE Stucco bungalow

AGE 32 Years

SIZE 139.4 M^2

INSULATION Walls - Block & Foil. Batts & Blown-in insulation in attic.

OCCUPANTS FAMILY SIZE 4

HABITS Often opens windows. Sometimes turns up heat at night to heat a bedroom.

COMPLAINTS Add-on kitchen area is cool. Ducts leading to this area pass through an unheated crawl space.

FURNACE - TYPE Oil. .75 nozzle

AGE 3-4 years SYSTEM CONDITION Plenty of supply and return outlets. Furnace was clean and in good condition. Fan on-off temperature was reduced. The oil filter was changed.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	74%	77%
- NET STACK TEMP. -	285.6°C	267.2°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	57.2°C	57.2°C
" " RISE	40.7°C	36.9°C
" KILOWATTS	22.8 kwh	28.7 kwh (+4%)
% OF KILOWATTS DEL'D.	45.3%	46.3%
Air Volume DEL'D.	71.8%	69.1%

COMMENTS Delivered Kwhs. increased by 6.4% and air volume by 10.5%. Air flow to the add-on kitchen was increased by pulley adjustment, thus increasing heat delivered to this area.

FUEL RECORD ANALYSIS 1981 to 1982 kwh./degree day = 10.82

1982 to 1983 kwh./degree day = 11.82

Average kwh./degree day = 11.22

FUEL CONSUMPTION IMPROVEMENTS Kwh./degree day after tune-up = 12.65

Oil consumption increased 12.7%

RETROFIT OPPORTUNITIES & COSTS

Option (1) Plenum Heater

The furnace is relatively new and in good condition so a plenum heater is a viable option. Cost would be $1400 less the after tax COSP Grant of $490* = $910. Annual savings will be $130/year providing a pay-back period of 7 years.

Option (2) Gas Conversion Burner (Recommended)

It would cost $1300 to install a conversion burner and chimney liner less a COSP Grant of $455* = $845. Savings would be $250/year giving a pay-back of 3.38 years.

Option (3) Insulate Ducts

Cost would have to be determined by contractors.

* Based on 30% tax bracket.

ENERGY CONSUMPTION

HOUSE #1

OIL

BEFORE TUNE-UP

November 6, 1981 to March 31, 1982 = 3275L

= 35472 kwh.

Applicable degree days = 3279

= 10.82 kwh/degree day

November 15, 1982 to March 13, 1983 = 2412L

= 26124 kwh.

Applicable degree days = 2211

= 11.82 kwh/degree day

AFTER TUNE-UP

March 30, to April 14, 1983 oil consumption = 204L

= 2209.5 kwh.

Applicable degree days = 174.6

= 12.65 kw./deg. day

OPTIONAL ENERGY SAVING RETROFITS

HOUSE #1

Oil Consumption = 3275L/year x $.32/L = $1048

annual kwh. = 35472

OPTION (1) PLENUM HEATER

Based on a 60% seasonal efficiency*, electric requirements to heat this house would be .60 x 35472 = 21283 kwh.

cost at $.0411/kwh. would be $875

*Assuming the oil furnace seasonal efficiency is 60%

A plenum heater that reduced oil consumption by 75% would provide the following savings:

.25 x $1048 =	$262
.75 x $875 =	656
Total	$918

Savings = $1048 - $918 = $130/year

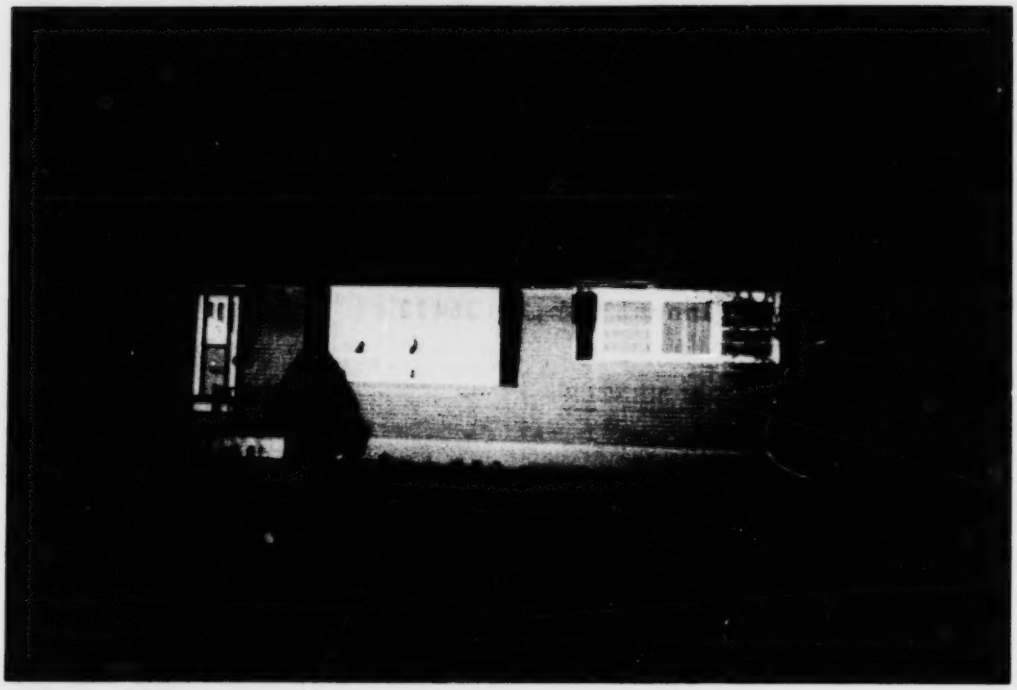
OPTION (2) CONVERSION GAS BURNER

A gas conversion burner would use 3427.25 M^3 of gas.

Based on an average monthly gas consumption of 285.6 M^3 (3427 ÷ 12 mos. the monthly cost would be $66.46 = $797.57 annually.

Savings over oil = $1048 - $798 = $250/year.

HOUSE #2



Twenty-Eight Year Old Bungalow
Located In Woodbridge

Air Leakage Around This
Disconnected Humidifier Was
Reduced With Duct Tape

HOUSE #2

Service Technician Tuning Up
The Twenty-Eight Year Old Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 2 ADDRESS Woodbridge

BUILDING DESCRIPTION - TYPE Brick Bungalow

AGE 28 Years

SIZE 80.3 M^2

INSULATION Walls none. Unknown amount added to ceiling.

OCCUPANTS FAMILY SIZE 1

HABITS Doesn't touch thermostat

COMPLAINTS Drafts. Removal of plastic deflectors eliminated drafts.

FURNACE - TYPE Oil .75 gph oil

AGE 28 Years SYSTEM CONDITION Good. Air on fire and draft adjusted. The blower assembly could not be removed to clean. Oil filter was changed.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	55%	73%
- NET STACK TEMP. -	199°C	190°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	65.6°C	60°C
" " RISE	42.2°C	36.1°C
" KILOWATTS	16.9 kwh.	22.5 kwh.
% OF KILOWATTS DEL'D.	51%	38.5%
Air Volume DEL'D.	74%	52%

COMMENTS Though the furnace output was increased by 33%, it was not possible to capture this heat and deliver it to the house. Therefore, the indicated bonnet temperature and air volume after tune-up are only theoretical and not actual.

FUEL RECORD ANALYSIS 1981 - 82 kwh./degree day = 8.11

1982 - 83 kwh./degree day = 7.18

average = 7.73 kwh./degree day

FUEL CONSUMPTION IMPROVEMENTS After tune-up

kwh./degree day = 1.92

Oil flow meter may have malfunctioned. If accurate, this equals a 76% reduction.

RETROFIT OPPORTUNITIES & COSTS

The furnace in this house is very old and not in sufficiently good condition to add either a plenum heater or a conversion gas burner. The electrical system is only 60 amps. so it would have to be upgraded considerably to enable an electric furnace to be installed. The owner does not want gas in the house.

An Amana type gas furnace, that is placed outside the house might be acceptable to the owner. However, its $3000 price, even with a net $560 COSP Grant, may be to expensive for the occupant. The Amana unit's performance, from preliminary field tests being undertaken by the Ministry, does not seem to perform up to expectations and thus may not be suitable for this project at this time.

The recommended option for this home would likely be a medium efficiency gas furnace. Pay-back would be 4 to 5 years.

ENERGY CONSUMPTION

HOUSE #2

OIL

BEFORE TUNE-UP

1981 - 82 - 3156 L oil

= 34186 kwh.

Applicable degree days = 4217

= 8.11 kwh/deg. day

1982 - 83 - 1941 L oil

= 21024.6 kwh.

Applicable degree days = 2929

= 7.18 kwh/deg. day

AFTER TUNE-UP

March 24, 1983 to April 8, 1983 litres of oil consumed = 43.5*

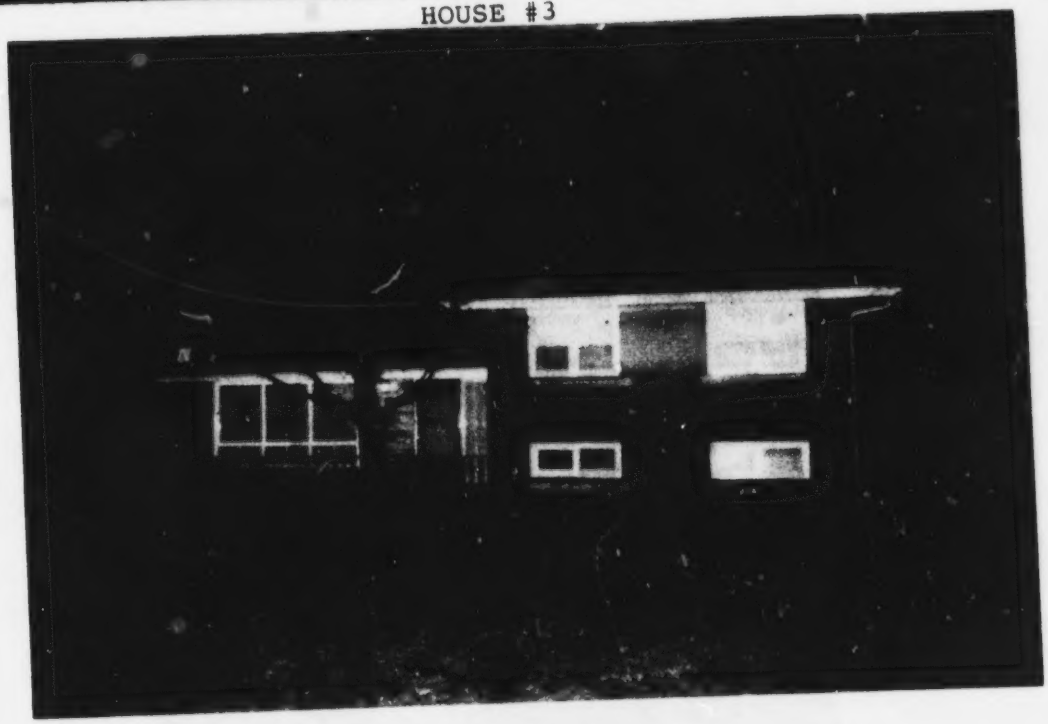
= 471.2 kwh.

Applicable degree days = 245

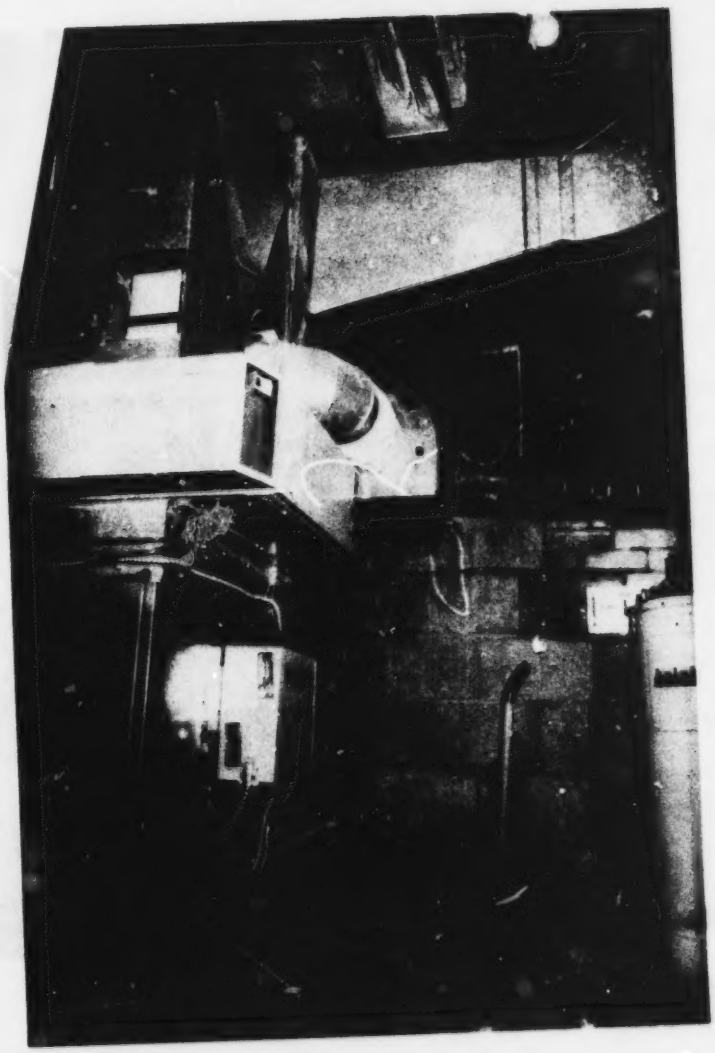
Kwh/deg. day = 1.92

* Meter may have malfunctioned. Monitoring in Phase II may provide a more accurate figure.

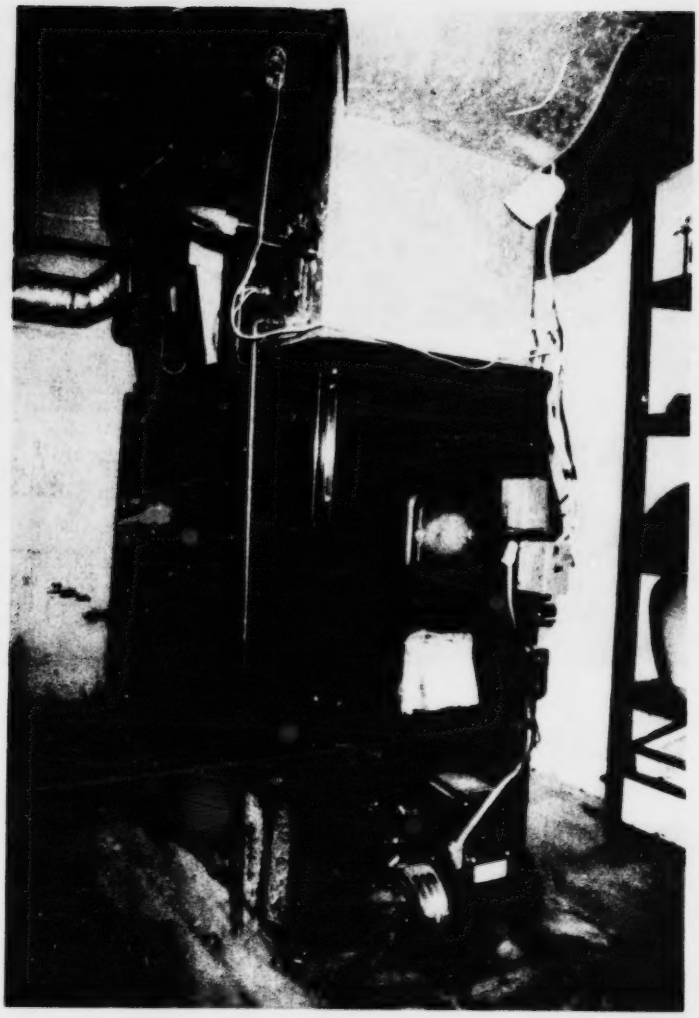
HOUSE #3



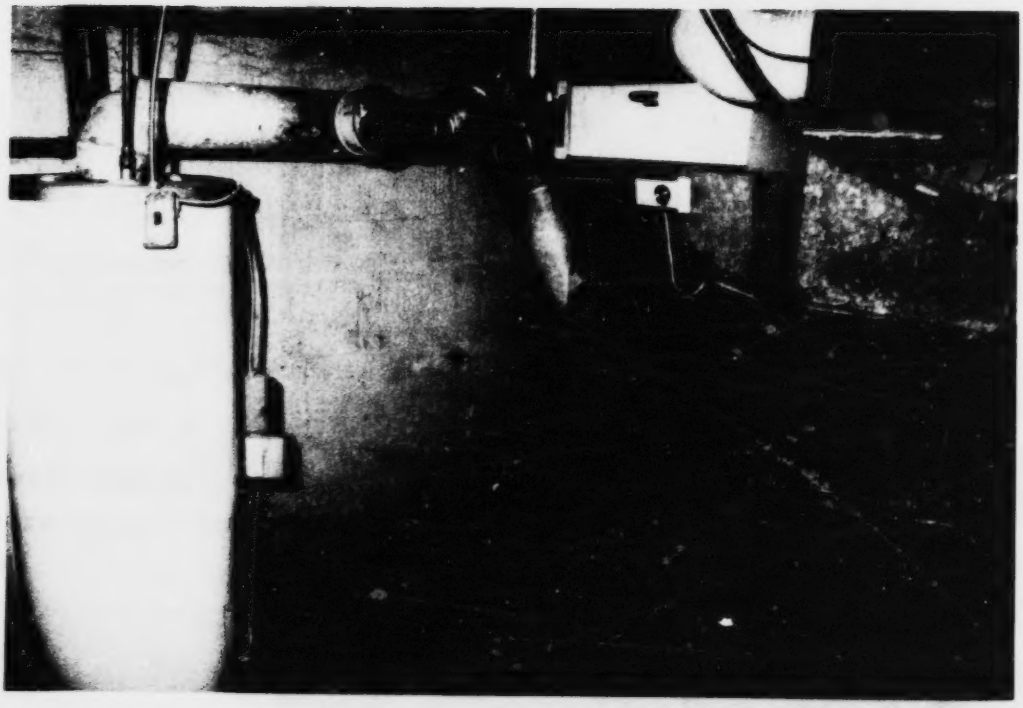
Sidesplit In Maple



Incorrectly Installed
Electronic Air Cleaner

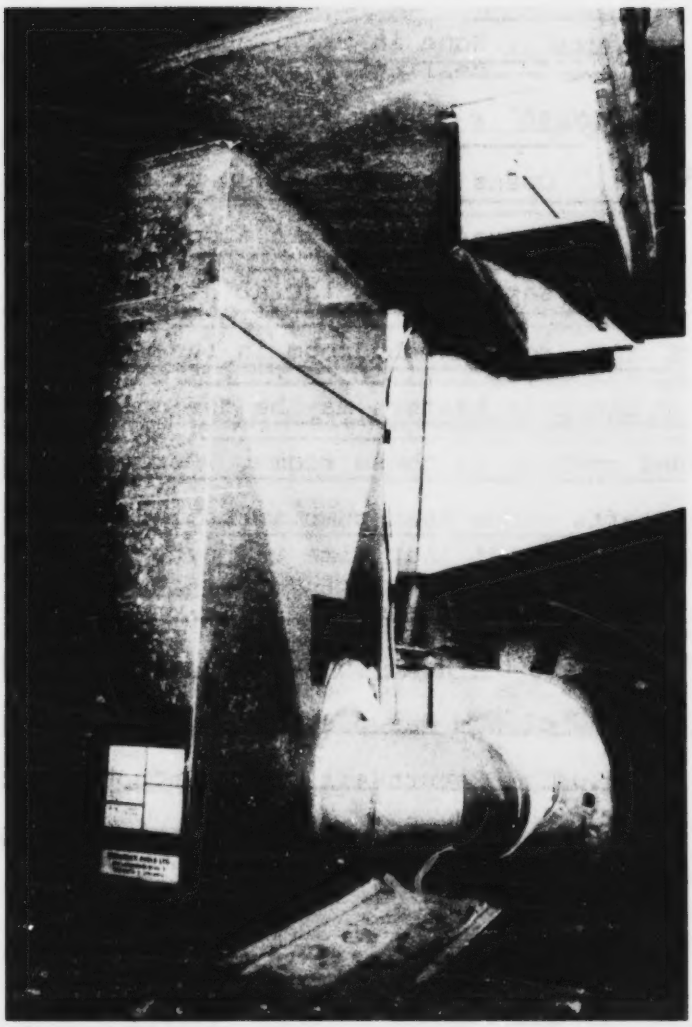


Heat Pump On
Twenty-three
Year Old Oil
Furnace



**Oil Water Heater Linked
To Furnace Flue**

HOUSE #3



Return Air Inlet Located Too
Close To Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 3 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Brick Side Split

AGE 23 Years

SIZE 102.2 M^2

INSULATION None in wall. Unknown amount added to ceiling.

OCCUPANTS FAMILY SIZE 4

HABITS Opens bedroom window at night. Leaves thermostat alone. Occasionally sets it back 1°C at night.

COMPLAINTS T.V. room and bedroom in basement are cool. Baseboard electric heaters may be the only way to provide year round comfort in these rooms. Occupants complained of cold drafts since heat pump installed. Furnace was set on continuous run at that time and plastic deflectors were added. Removal of reflectors eliminated drafts to occupant's satisfaction.

FURNACE - TYPE Oil with 2-ton heat pump

AGE 23 yrs. SYSTEM CONDITION Heat pump added in July 1982. Return air inlet on R.A. plenum was picking up products of combustion. This opening was taped off. Return air should not be within 1.8 M of furnace. Return air would be better in other basement rooms.

		BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	Oil	50%	45%
- NET STACK TEMP. -	Oil	398.3°C	453.9°C

		BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	Oil	46.1°C	42.2°C
" " RISE	Oil	22°C	18.2°C
" KILOWATTS	Oil	15.4 kwh.	13.8 kwh.
% OF KILOWATTS DEL'D.	Oil	9.5%	17.7%
Air Volume DEL'D.	Oil	18.6%	25.9%

COMMENTS Unable to improve oil furnace efficiency, but this is not too important as it is only back-up for the heat pump. Delivered kwhs. were increased by 67.6%, mostly due to a 51% increase in delivered air volume through taping. Unable to increase blower speed because of defective bearing. Delivery efficiency probably low because system is not designed to carry the cfm. being produced.

FUEL RECORD ANALYSIS

1981-1982 oil kwh./degree day = 6.92

1982-1983 oil kwh./degree day = 7.97

1983 heat pump kwh./degree day =

FUEL CONSUMPTION IMPROVEMENTS

Information not available. Electrical bills were too inconsistant to be able to subtract other electrical usage from the heat pump usage. Similar months, prior to the heat pump, often showed higher electrical consumption than after.

RETROFIT OPPORTUNITIES & COSTS

Option(1) Return Airs In Basement (Recommended)

The two finished rooms in the basement should have return-airs added, however, thermostatically controlled baseboard heaters would provide better year round comfort. The cost of adding return-airs would require a contractors on-site estimate. Pay-back period, if any, underminable.

Option(2) Replace Fan Motor (Recommended)

The fan motor has a defective motor preventing an increase in air-flow. The cost would have to be determined. Increased airflow would increase efficiency but pay-back period would be difficult to access. This would be the most worthwhile option.

Option(3) Modify Return Air Plenum For Air Cleaner

The plenum should be tapered to fit the air cleaner, to prevent ozone build-up. Cost would be about $200. No pay-back likely, as this is a safety measure not an energy efficiency improvement.

ENERGY CONSUMPTION

HOUSE #3

OIL

BEFORE TUNE-UP

1981 - 82 = 2,695 litres

= 29,198 kwh.

applicable degree days = 4,217

= 6.92 kwh./degree day

1982 - 83 = 2,168 gal. oil

= 23,347 kwh.

applicable degree days = 2,929

= 7.97 kwh./degree day

AFTER TUNE-UP

kwh. between May 4/83 and May 13/83 = 419 kwh.

Less other usage _____* kwh. = _____* kwh. htg.

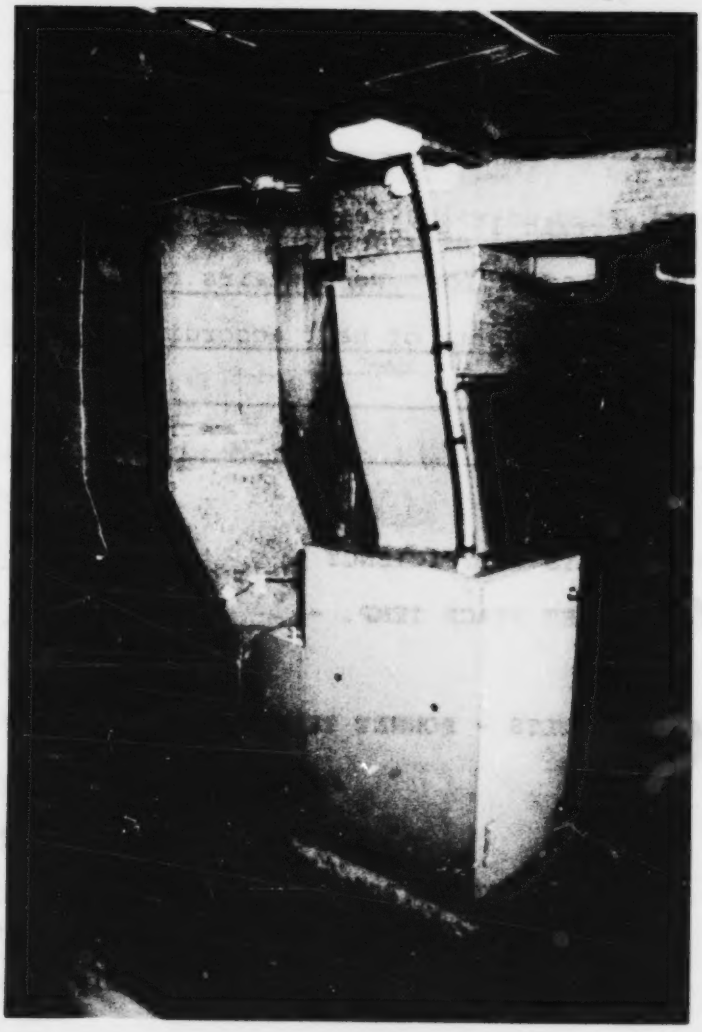
applicable degree days = 153.4 (F^{o})

kwh./degree day = _____*

*Previous electrical bills are too inconsistant to obtain a meaningful indication of what other usage might be.

HOUSE #4

Thornhill House With Wood Siding



Electric Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 4 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Wood siding - storey and one half and addition

AGE 30 years

SIZE 58 M^2 main house, 71 M^2 in addition

INSULATION Walls 7.62 cm. Unknown amounts in ceiling.

OCCUPANTS FAMILY SIZE 2

HABITS The addition is for overnight family visits. It is not heated when not in use. This area is heated with electric baseboard heaters. Owner does not set back thermostat.

COMPLAINTS None

FURNACE - TYPE Electric 15 to 16.4 kwh.

AGE Unknown SYSTEM CONDITION No upstairs return air however, high wall outlets deliver plenty of heat according to owner.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	Not applicable	
- NET STACK TEMP. -	"	"

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	65.6°C	65.6°C
" " RISE	44.4°C	44.4°C
" KILOWATTS	15 kwh.	15 kwh.
% OF KILOWATTS DEL'D.	38.4%	38.4%
Air Volume DEL'D.	79.6%*	79.6%*

Bonnet cfm is probably understated.

COMMENTS The blower assembly was cleaned but it made no difference in air volume delivered. The blower alignment was adjusted. The owner has balanced the system himself.

FUEL RECORD ANALYSIS 1981 - 82 kwh./degree day = 5.53

1982 - 83 kwh./degree day = 3.5

Average kwh./degree day = 4.7

FUEL CONSUMPTION IMPROVEMENTS After tune-up

kwh./degree day = 4.35

Energy for heating reduced by 7.5%

RETROFIT OPPORTUNITIES & COSTS

There is likely little opportunity to make worthwhile retrofit changes to this house in Phase 2.

ENERGY CONSUMPTION

HOUSE #4, THORNHILL

ELECTRIC

BEFORE TUNE-UP

1981 - 82 kwh. for heating = 22,660

applicable degree days = 4,099

kwh./degree day = 5.53

1982 - 83 kwh. for heating to Mar. 30 = 10,440

applicable degree days = 3,007

kwh./degree days = 3.5

AFTER TUNE-UP

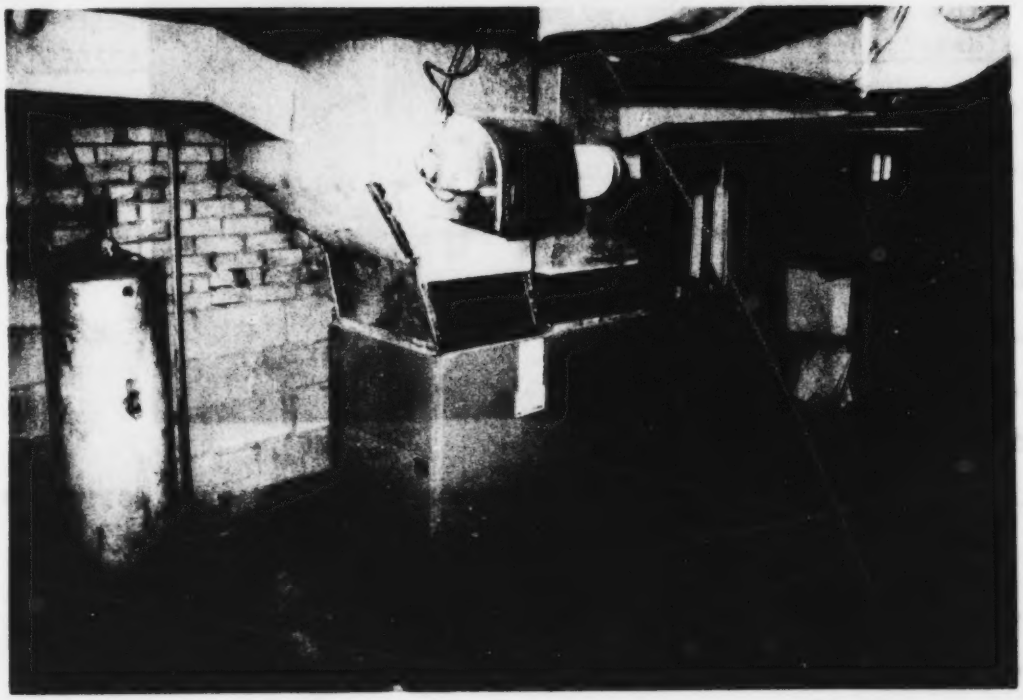
kwh. between April 1/83 and May 30/83 = 2,550 kwh.

applicable degree days = 586

kwh./degree day = 4.35

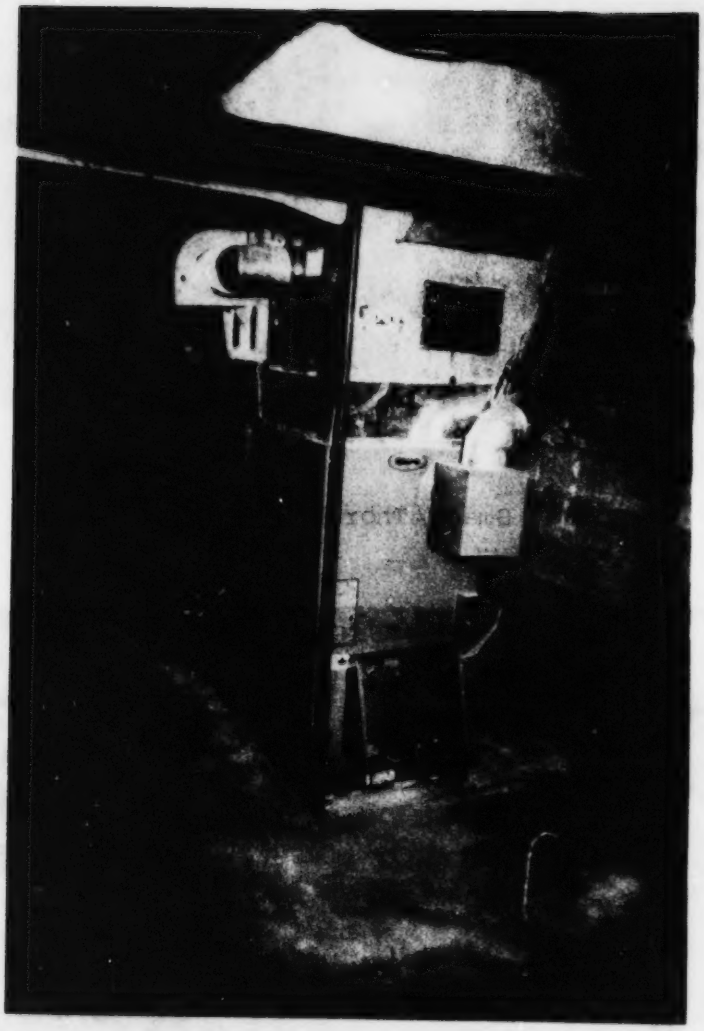
HOUSE #5

Small Thornhill House



New Gas Furnace

HOUSE #5



New Gas Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 5 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Bungalow - (Stucco)

AGE 40 + years

SIZE 93 M^2

INSULATION Walls none. Possibly R28-R40 in attic.

OCCUPANTS FAMILY SIZE 2

HABITS Manually sets back thermostat at night. Husband sleeps with window open. Wife airs house in morning.

COMPLAINTS Back N.E. bedroom cool but better with new furnace.

FURNACE - TYPE Gas. 28.9 kwh. input. 22.7 kwh. output.

AGE 2 months SYSTEM CONDITION Duct system needs considerable taping. Furnace cycled too frequently. Thermostat anticipator adjusted.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	75.7%	78.5%
- NET STACK TEMP. -	124.4°C	132.2
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	48.9°C	54.4°C
" " RISE	30.5°C	36.1°C
" KILOWATTS	22.6 kwh.	23.5 kwh.
% OF KILOWATTS DEL'D.	31%	35%
Air volume DEL'D.	32.8%	37.9%

COMMENTS Thermostat anticipator adjusted. Delivered kws. increased by 16% (7.0 to 8.2) because of increased furnace efficiency. Total delivered air volume did not increase because of the greater damper restrictions resulting from air balancing to owner's requirements. Balancing increased kwh's. delivered to cool room by 42%.

FUEL RECORD ANALYSIS kwh./degree day Jan. 19/83 to Feb. 16/83 = 8.75.*

FUEL CONSUMPTION IMPROVEMENTS kwh./degree day after tune-up = 1.89*

*Actual meter readings do not correspond with interim bill amounts shown on gas bill.

RETROFIT OPPORTUNITIES & COSTS

Owner manually sets back thermostat, therefore, a set back thermostat will not save any further energy.

Since this is a new gas furnace, no other retrofit options are limited to duct taping.

DUCT TAPING

Duct taping would cost approximately $100. Savings to be determined through monitoring in Phase II.

ENERGY CONSUMPTION

HOUSE #5

GAS

BEFORE TUNE-UP

Gas consumed between January 19, 1983 and February 16, 1983 = 524 M^3*

= 5423.4 kwh.

Applicable degree days = 620

kwh./degree days = 8.75

AFTER TUNE-UP

March 16 to May 13 consumption = 142 M^3 Gas*

= 1470 kwh.

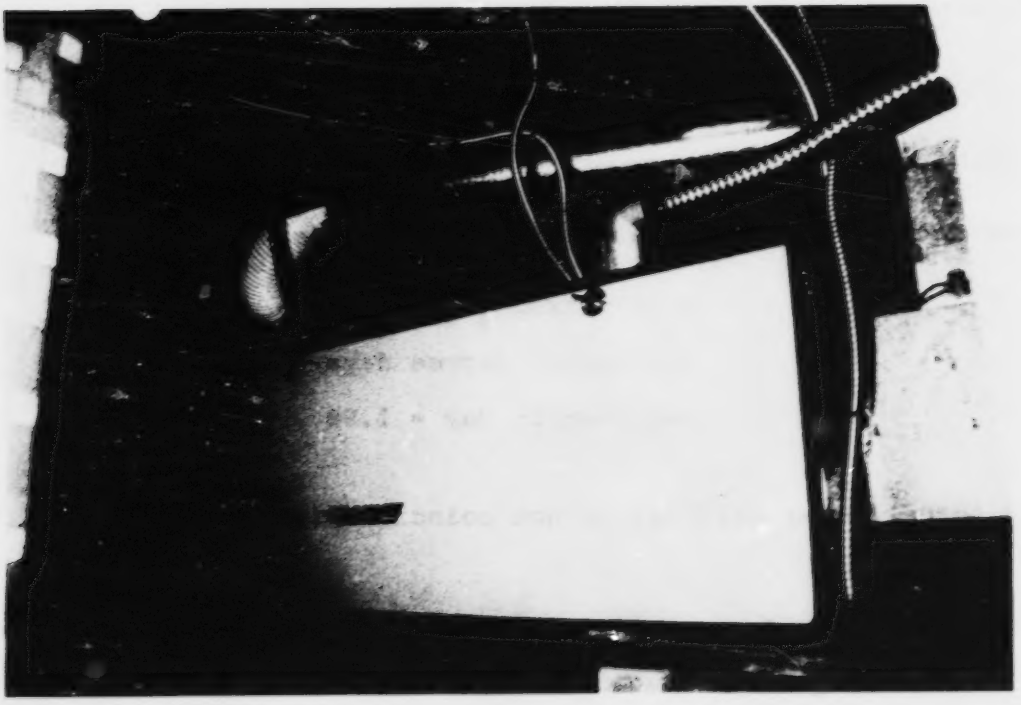
Applicable degree days = 776

kwh./degree day = 1.89

* Actual meter readings do not coincide with gas bills.

HOUSE #6

Custom Built Thornhill Home



Experimental Electric Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 6 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Brick ranch style bungalow w/built on s. sunroom.

AGE 17 years

SIZE 157.9 M^2

INSULATION 10.2 cm. in walls. Unknown amount blown in attic.

OCCUPANTS FAMILY SIZE 2

HABITS Has three zone system with three thermostats. Does not set back at night. Has sun-room that is heated with baseboard heaters.

COMPLAINTS None. Built house and system himself. Did a first class job. Furnace was not operating properly as was cycling on limit. This was repaired so that tune-up could be completed.

FURNACE - TYPE Experimental three zone electric with built in A/C and elect. air cleaner.

AGE 17 years SYSTEM CONDITION Furnace was in poor condition until repairs made, but the distribution system is well designed and made.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	Output unknown	
- NET STACK TEMP. -	None	

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	82.2°C	50.6°C
" " RISE	63.8°C	30.5°C
" KILOWATTS	Furnace output unknown	
% OF KILOWATTS DEL'D.	unknown *	
air volume DEL'D.	unknown *	

*This furnace was an experimental model with no name plate.

COMMENTS Furnace had no name plate. Delivered btuh. increased 6.2% and delivered air volume by 21.6%. This increase along with the repair will be the only improvements made that will improve efficiency.

FUEL RECORD ANALYSIS 1981 - 82 kwh./degree day = 5.5

1982 - 83 kwh./degree day = 5.3

Average kwh./degree day = 5.4

FUEL CONSUMPTION IMPROVEMENTS After tune-up

April 22 - May 13 kwh./degree day = 1.9

May's hydro bill indicated 2.5 kwh./degree day in May. Based on the latter, tune-up reduced electrical energy for heating by 54%.*

RETROFIT OPPORTUNITIES & COSTS

This furnace has a unique three zone system. The method of zoning and the connecting duct work would make it very difficult to replace this furnace. Since an air conditioner and electronic air cleaner are built in, they would have to be replaced also. The finished basement would make the necessary changes in the duct work from a three zone system to a single zone system very difficult and expensive.

I do not believe any practical Phase II improvements can be made.

*This is probably realistic because furnace was malfunctioning prior to tune-up.

ENERGY CONSUMPTION

HOUSE #6, THORNHILL

ELECTRIC

BEFORE TUNE-UP

1981 - 82/kwh. for heating = 22,520

applicable degree days = 4,109

kwh./degree day = 5.5

1982 - 83/kwh. for heating season to April 30/83 = 17,810 kwh.

applicable degree days = 3,378

kwh./degree day = 5.3

AFTER TUNE-UP

Kwh. between April 22 and May 13, 1983 = 966 kwh.

Less other electrical kwh. = 490 kwh. = 476 kwh.

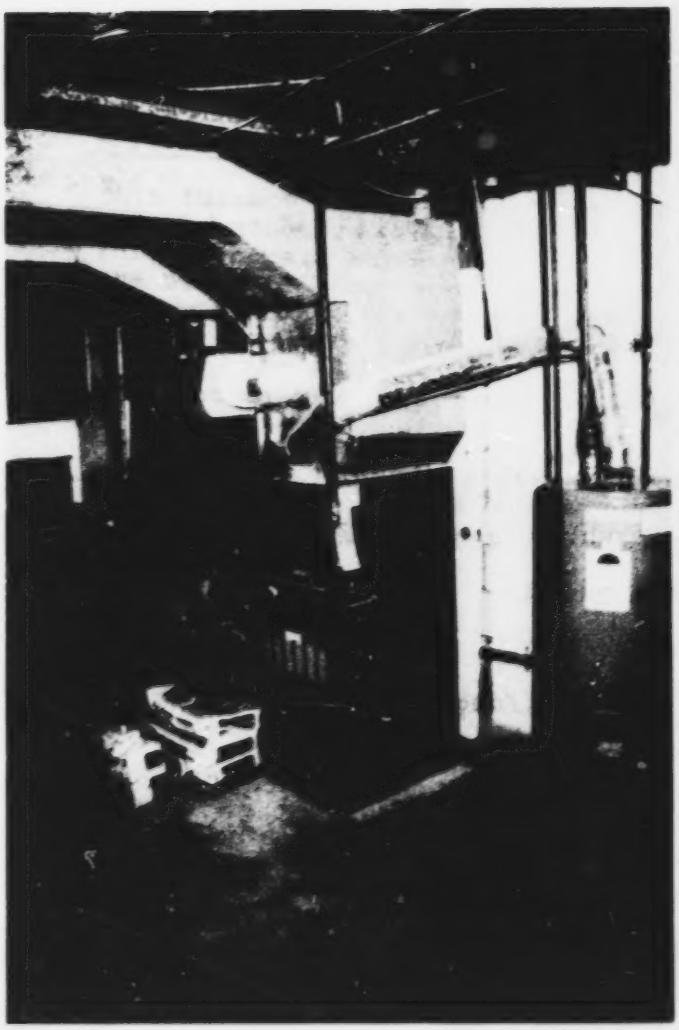
Applicable degree days = 251

kwh./degree day = 1.9

May hydro bill indicated kwh./degree day of 2.5

HOUSE #7

Twenty-six Year Old Brick Bungalow



Two Year Old Gas Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 7 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Brick bungalow

AGE 26 years

SIZE 111 M^2

INSULATION None in walls. Some added to ceiling under CHIP.

OCCUPANTS FAMILY SIZE 5

HABITS Sets thermostat back 1.7°C

Uses dangerously cracked Franklin fireplace.

Owner was alerted to danger during our visit.

COMPLAINTS Back north facing bedrooms were cool.

FURNACE - TYPE Gas. 30.8 kwh. input. 24.6 kwh. output.

AGE 2 years SYSTEM CONDITION Appeared to be good. Much concealed by finished basement.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	76%	77%
- NET STACK TEMP. -	160°C	143°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	76.7°C	71.1°C
" " RISE	56.1°C	46.6°C
" KILOWATTS	23.4 kwh.	23.7° kwh.
% OF KILOWATTS DEL'D.	60%	65.5%
Air Volume DEL'D.	89%	96%

COMMENTS Delivered Btuh. increased 11.4% (14.0 kwh. to 15.5 kwh.) and delivered air volume increased 31.3%. In order to deliver more air, blower speed was increased from low to high. This along with some taping resulted in .23 more kwhs. being delivered to one bedroom (+6%) and .11 kwh. to the other (+10%).

FUEL RECORD ANALYSIS 1981-1982 kwh./degree day = 6.95

1982-1983 kwh./degree day = 7.14

average kwh./degree day = 7.04

FUEL CONSUMPTION IMPROVEMENTS After tune-up, kwh. = 7.07/degree day Consumption increased by .4%. Short monitoring time may have distorted results. Continuing monitoring in Phase II will give a more accurate picture.

RETROFIT OPPORTUNITIES & COSTS

The occupant sets back thermostat 1.7°C manually. Providing an automatic set-back thermostat, may encourage the owner to set back a little further. However, since the bedrooms were already a little cool prior to the tune-up, the occupants may be reluctant. At this point, it would be difficult to determine the savings, if any, that would be incurred.

ENERGY CONSUMPTION

HOUSE #7

GAS

BEFORE TUNE-UP

Gas consumed between September 4, 1981 and May 6, 1982 = 3108 M^3

Less 320 M^3 for hot water = 2788 M^3

= 28,844.9 kwh.

Applicable degree days = 4151.4

kwh./degree days = 6.95

Gas consumed between September 7, 1982 and May 5, 1983 = 2737 M^3

Less 320 M^3 for hot water = 2417 M^3

= 25006.4 kwh.

Applicable degree days = 3503

kwh./degree days = 7.14

AFTER TUNE-UP

Gas used between March 13, 1983 and May 22, 1983 = 549.30 M^3

Less 93.3 M^3 for water heater = 456 M^3

= 4719.6 kwh.

Applicable degree days = 667.6

kwh./degree days = 7.07

HOUSE #8

Twenty-three Year Old Brick Side Split

New Gas Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 8 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Side Split

AGE 23 Years

SIZE 102.2 M^2

INSULATION None wall. R30 in attic (CHIP Grant)

OCCUPANTS FAMILY SIZE 3

HABITS Manually sets back at night and during weekdays.

COMPLAINTS Cooler in lower half of split level. Removal of filter pieces, stuck in outlets by owner, in lower level, significantly increased heat being delivered to this part.

FURNACE - TYPE Gas. Input 38.9 kwh. Output 26.3 kwh.

AGE 2 Years SYSTEM CONDITION Appears to be good. Ducts hidden by finished basement. Auxiliary baseboard heaters in basement.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	72.3%	79.4%
- NET STACK TEMP. -	115.6°C	110°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	65.6°C	62.8°C
" " RISE	41.25	38.5°C
" KILOWATTS	23.73 kwh.	26.13 kwh.
% OF KILOWATTS DEL'D.	45%	42%
Air Volume DEL'D.	56.3%	50.6%

COMMENTS Kwh. delivered increased by 3% and air volume delivered decreased by 6%. Lowered fan on/off times. Fan belt was loose. Washable filter was cleaned. Main increase in furnace efficiency was due to adjustment of combustion air. Badly leaking ducts were taped.

FUEL RECORD ANALYSIS The average kwh./degree day in 1982 - 83 was 26.4.

FUEL CONSUMPTION IMPROVEMENTS Average kwh./degree day after the tune-up was 20.2.

Fuel savings = 23.5%

RETROFIT OPPORTUNITIES & COSTS

Since this house has a new gas furnace and a finished basement, little can be done in Phase 2. Owner manually sets back thermostat so a set back thermostat may provide convenience but it will not provide further energy savings.

ENERGY CONSUMPTION

HOUSE #8

GAS

BEFORE TUNE-UP

March 82 - February 83 gas consumption = 9653 M^3

less 1699 M^3 for water heater = 7954 M^3

= 8332.7 kwh.

Applicable degree days = 3113.6

= 26.4 kwh/degree day

AFTER TUNE-UP

Gas consumption March 11 to April 26, 1983 =

1602.3 M^3 less 218 M^3 for hot water

= 1384.3 M^3

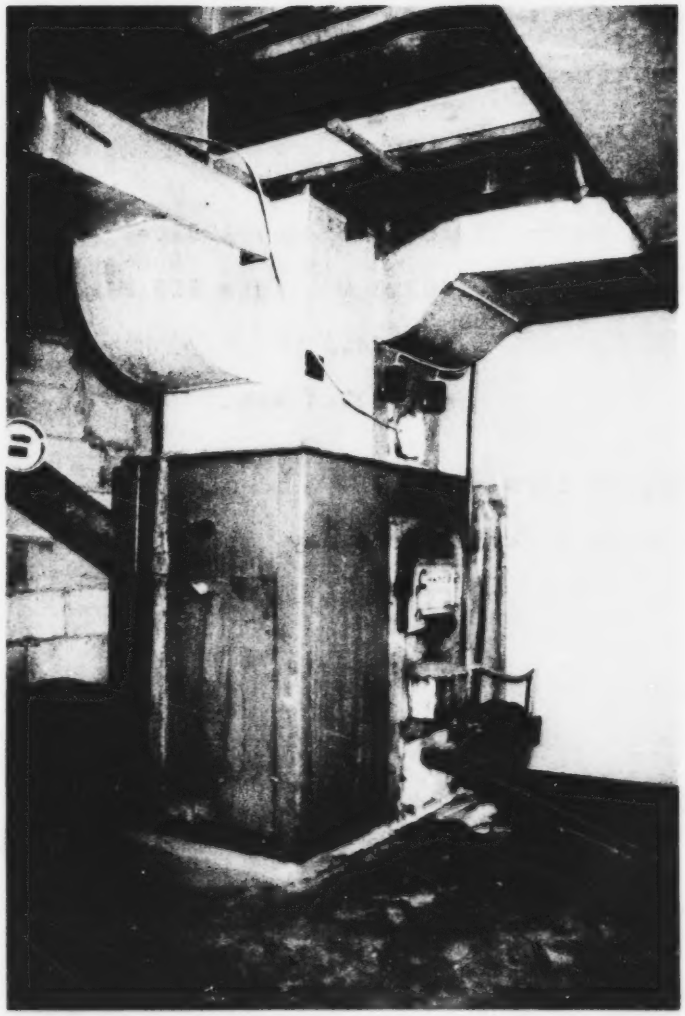
= 14327.4 kwh.

Applicable degree days = 709.7

= 20.2 kwh/degree day

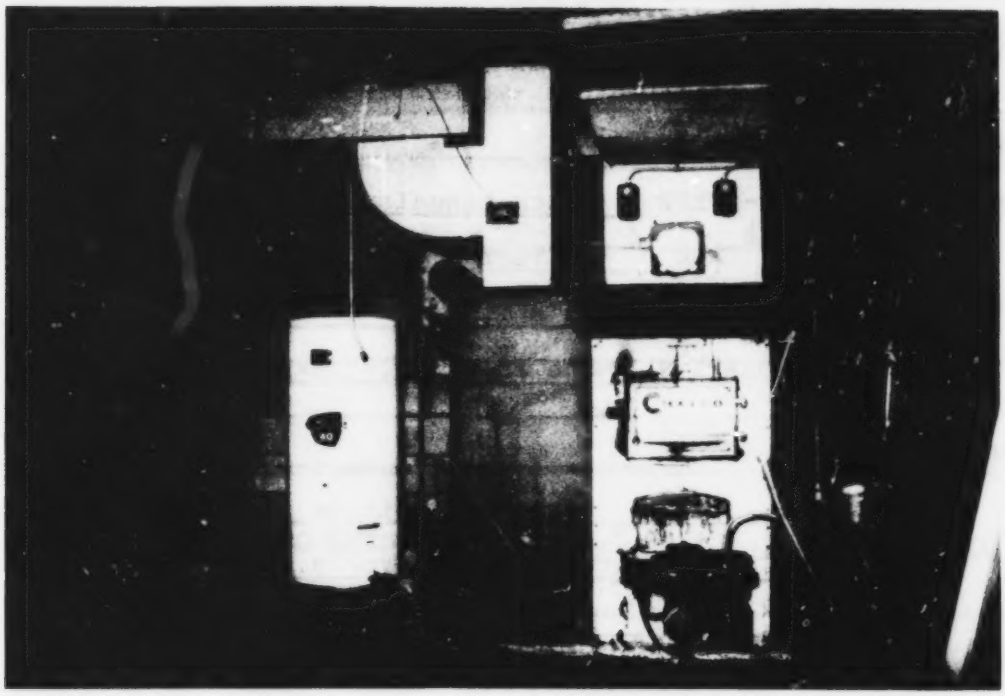
HOUSE #9

Thirty Year Old Brick Bungalow

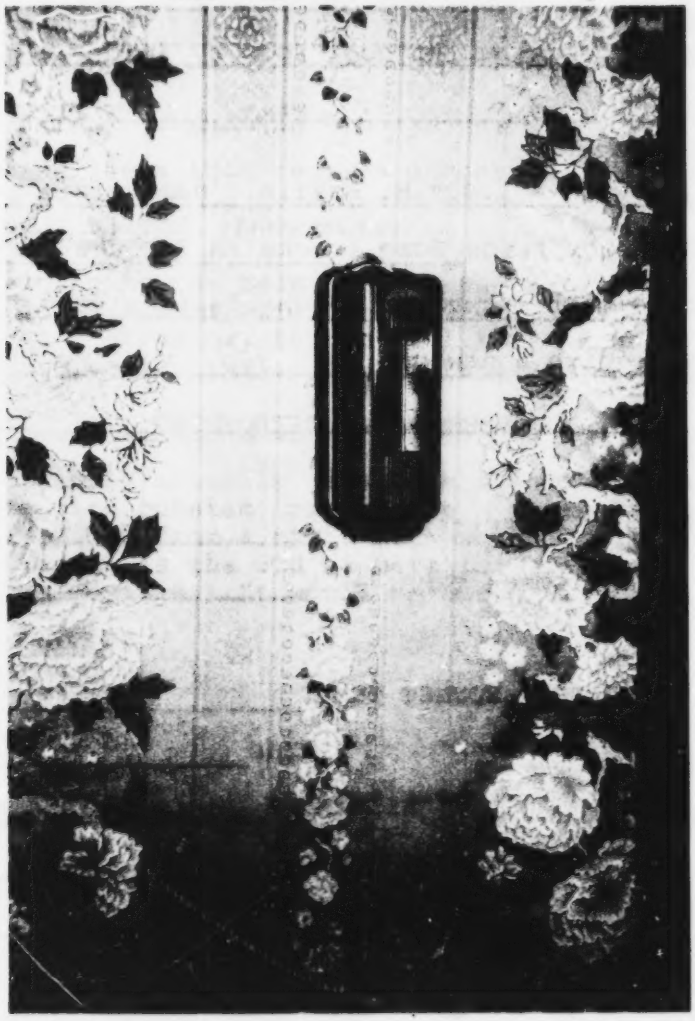


Oil Furnace Of
Unknown Age

HOUSE #9



Oil Furnace Of Unknown Age



Old Bi-Metalic
Thermostat

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 9 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Brick bungalow

AGE 30 Years

SIZE 93 M^2

INSULATION None in walls. Unknown amount added to attic

OCCUPANTS FAMILY SIZE 2

HABITS Varies thermostat setting in accordance with outside temperature. Sets back 5.6°C manually at night.

COMPLAINTS Back part of house is cool. Ducts need to be insulated. Balancing and other tune-up measures increased heat being delivered to cool room by 36%.

FURNACE - TYPE Oil, with a 1.G.P.H. nozzle. Name plate unaccessible.

AGE Unknown SYSTEM CONDITION Some cracks in furnace fire brick. Residue baked on to heat exchanger -- unable to clean. Fan limit inaccurate. May require a new one.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	69.6%	74.5%
- NET STACK TEMP. -	283.3°C	253.3°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	73.9°C	79.4°C
" " RISE	54.4°C	55.6°C
" KILOWATTS	28.6 kwh.	30.6 kwh.
% OF KILOWATTS DEL'D.	22%	20%
Air Volume DEL'D.	33%	33%

COMMENTS To provide more heat to cool areas of the house, the heat to three rooms was severly dampered. This caused total system restrictions lowering delivery efficiency.

FUEL RECORD ANALYSIS 1981 - 82 kwh/degree day = 6.0

1982 - 83 kwh/degree day = 6.1

FUEL CONSUMPTION IMPROVEMENTS Oil flow meter failed. No immediate data.

RETROFIT OPPORTUNITIES & COSTS

There are three items that require attention.

OPTION (1) DUCT SYSTEM (Recommended)

The ducts leading to the back part of the house should be increased in size, to deliver more air to this area. Costs would have to be estimated by a contractor, but would likely be under $500. Pay-back period undeterminable.Insulation of the ducts should also be considered.

OPTION (2) SET-BACK THERMOSTAT (Recommended)

The owner currently manually sets back thermostat and varies setting in accordance with outside temperature. These habits would normally indicate no savings from a night set-back thermostat, however, the current thermostat is the old bi-metalic type and a more modern type may bring some savings. It would be difficult to determine the amount.

Continued.....

	OPTION (3) CONV.GAS FURNACE	RECOMMENDED OPTION (4) MED. EFFIC. GAS FURNACES	OPTION (5) HIGH EFFIC. GAS FURNACES
COST	$1500W/Liner	$1900	$2400
COST LESS COSP*	$ 975	$1340	$1840
SAVINGS/YR.	$ 135	$ 245	$ 297
PAY-BACK	7.2 years	5.4 years	6.2 years

*Assuming a 30% tax bracket.

Electrical furnace option not considered because of the need to upgrade the electrical service to the house. A plenum heater and conversion gas burner were also not considered because the age and condition of the furnace made them a poor long term consideration.

ENERGY CONSUMPTION

HOUSE #9, THORNHILL

OIL

BEFORE TUNE-UP

October 27/81 to June 22/82 oil consumption = 2139L

= 23168 kwh.

applicable degree days = 3857

kwh/degree day = 6.0

June 22/82 to March 22/83 oil consumption = 1671L

= 18098 kwh.

applicable degree days = 2972

kwh/degree day = 6.1

AFTER TUNE-UP

Not available. Meter failure.

RETROFIT ALTERNATIVES

Oil consumption = 2139L or 23168 kwh. input

Cost of oil = $684.50

OPTION (3)

CONVENTIONAL GAS FURNACE (60% SEASONAL EFFICIENCY)

M^3 required per year = 2238.5
Average monthly gas required = 186.5 M^3
Cost of this gas = $45.80
Annual gas cost = $549.60
Savings over oil = $134.90/year

MEDIUM EFFICIENCY GAS FURNACE (75% SEASONAL)

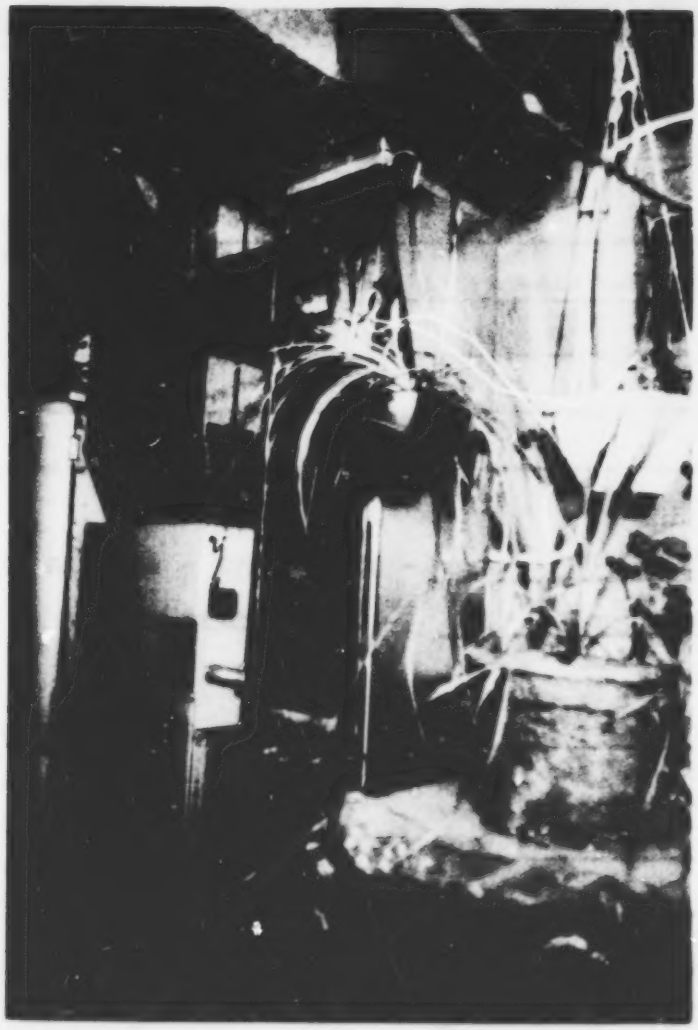
This furnace will use 20% less fuel resulting in a $439.70 gas bill annually.
Savings over oil = $244.80

HIGH EFFICIENCY GAS FURNACE (90% SEASONAL)

This furnace will use 66.6% of the gas that the conventional furnace would or 1490.8 M^3/yr.
Average monthly consumption = 124 M^3
Cost per month = $32.33
Yearly gas cost = $388
Savings over oil = $296.50/year

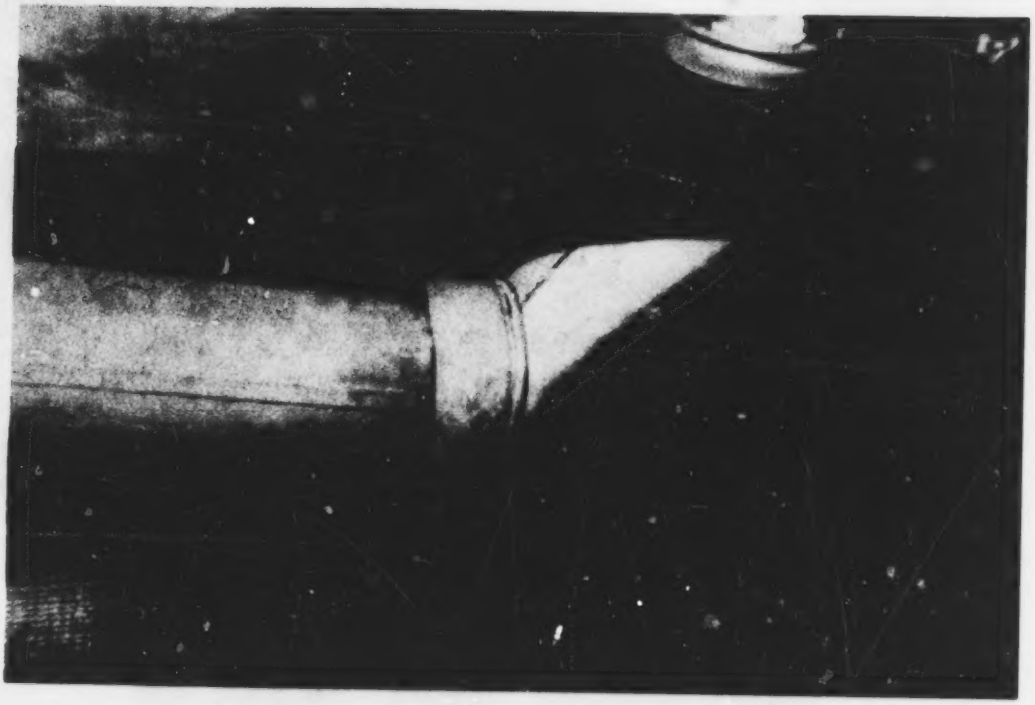
HOUSE #10

Twenty-Eight Year Old Woodbridge Bungalow



New Electric Furnace

HOUSE #10



Bad Duct To Boot Connection

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 10 ADDRESS Woodbridge

BUILDING DESCRIPTION - TYPE Bungalow - Brick

AGE 28 Years

SIZE 80.3 M^2

INSULATION Walls - none. Attic = R32

OCCUPANTS FAMILY SIZE 1

HABITS Used plastic deflectors. Heat shut off to all bedrooms. Keeps thermostat at 15°C except when home in evening. - 21°C. Opens bedroom window at night.

COMPLAINTS Cold drafts in living-room that began when new electric furnace installed last year. Owner installed plastic deflectors at same time.

FURNACE - TYPE Electric 20 Kw.

AGE 1 season SYSTEM CONDITION Some ducts were separated and had to be taped.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	100%	100%
- NET STACK TEMP. -	not applicable	
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	62.8°C	63.3°C
" " RISE	35°C	41.1°C
" KILOWATTS	20 kwh.	20 kwh.
% OF KILOWATTS DEL'D.	37.1%	56.3%
Air Volume DEL'D.	51.3%	71.6%

COMMENTS Most improvements came with duct taping. Owner does not want heat in bedrooms nor carpets cut to allow air in. Removal of plastic deflectors eliminated drafts to owner's satisfaction.

FUEL RECORD ANALYSIS 1980 - 81 oil = 5.8 kwh./degree day

1981 - 82 oil = 5.9 kwh./degree day

1982 - 83 electric = 5.04 kwh./degree day

Average kwh./degree day = 5.6

FUEL CONSUMPTION IMPROVEMENTS After tune-up kwh./degree day = 4.05

Fuel consumption reduced by 28% from average and 20% from previous years electric heating consumption.

RETROFIT OPPORTUNITIES & COSTS

The occupant works during the day and manually sets back the thermostat during the day and at night. The only possible retrofit to this system is a set-back thermostat. However, since the owner is already manually making the set-backs, there will be no fuel savings and possibly an increase in consumption if it is set to have the house warm before the owner returns. A micro processor unit would have to be used as the occupant's weekend pattern is different than on week days.

ENERGY CONSUMPTION

HOUSE #10, WOODBRIDGE

ELECTRIC

BEFORE TUNE-UP

1980 - 81 = 2,165.7 L. = 23,457 kwh.

degree days for this time = 4039

= 5.8 kwh./degree day

1981 - 82 = 2,300.7 L. oil = 24,919 kwh.

applicable degree days = 4,217

= 5.91 kwh./degree day

Dec. 1/82 - Mar. 30/83 electric kwh. = 11,700

applicable degree days = 2,322

kwh./degree day = 5.04

AFTER TUNE-UP

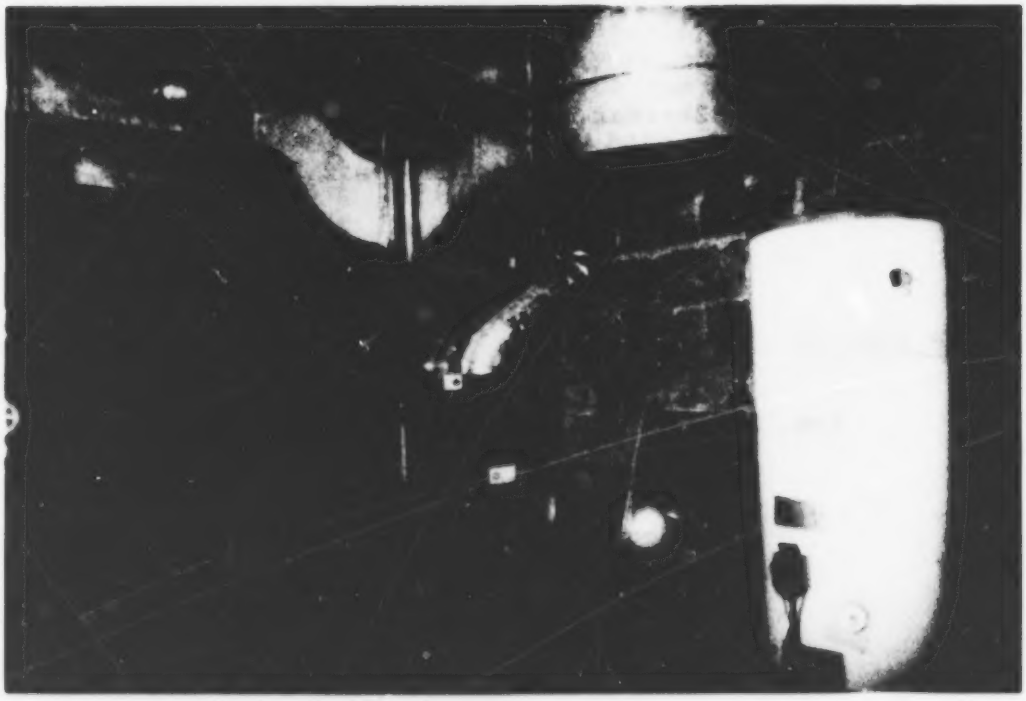
kwh. between May 1 and May 30 = 900 kwh.

applicable degree days = 222

kwh./degree days = 4.05

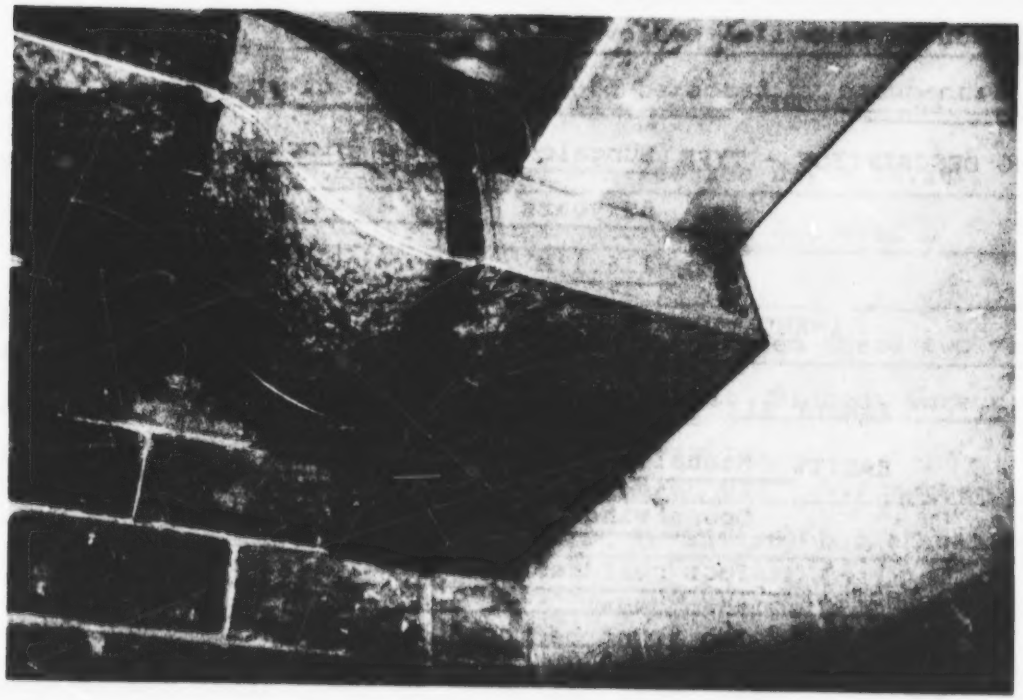
HOUSE #11

Kleinburg Bungalow With Poured Block Walls

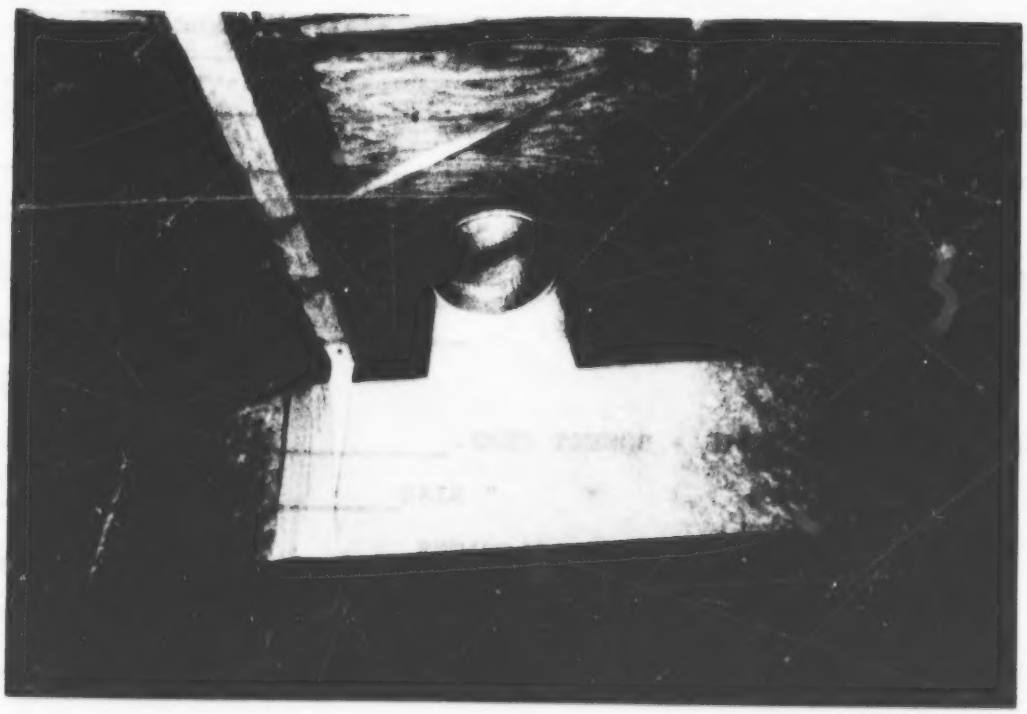


New Gas Furnace

HOUSE #11



Inefficient Duct Elbows



Basement Had Several Open Outlets Which
Delivered Too Much Heat To This Space

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 11 ADDRESS Kleinberg

BUILDING DESCRIPTION - TYPE Bungalow. Poured block solid walls.

AGE 60 years

SIZE 116.1 M^2

INSULATION 15 cm. blown into attic. None in walls of main house and 8.9 cm. in walls of addition.

OCCUPANTS FAMILY SIZE 6

HABITS Manually sets thermostat back 2.75°C at night. Opens window to air house in morning. The four children could indicate more door openings than usual.

COMPLAINTS Two front bedrooms cool. Back living room addition cool. Heat delivered to these areas was increased substantially through fan belt adjustment, taping off basement outlets and air balancing.

FURNACE - TYPE Gas. 38 kwh. input. 30.5 kwh. output.

AGE Inst. Jan82 SYSTEM CONDITION Anticipator adjusted to stop short cycling. Taped some loose supply air duct joints. Air filter needed cleaning.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	76%	77.6%
- NET STACK TEMP. -	151.1°C	140.6°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	60°C	57.2°C
" " RISE	38.5°C	33°C
" KILOWATTS	29 Kwh.	29.6 kwh.
% OF KILOWATTS DEL'D.	35%	40.3%
Air Volume DEL'D.	46.3%	43.3%

COMMENTS Delivered kwhs. increased 18%. This is a good increase considering air balancing often restricts total air volume delivered. Substantial comfort improvements should be noted by occupants.

FUEL RECORD ANALYSIS 1981-82 gas kwh./degree day = 16.86

1982-83 gas kwh./degree day = 10.0

Extreme difference between these two years is hard to understand. Figures were re-checked and confirm the results.

FUEL CONSUMPTION IMPROVEMENTS After tune-up gas kwh./degree day = 15.9 This is a 6% savings compared to 1981/82 but a considerable increase compared to 1982-83. The 82/83 figures are likely in error. Monitoring period was May 13 to June 9/83.

RETROFIT OPPORTUNITIES & COSTS

DUCT WORK

There are several inefficient sharp 90° turns in the supply air plenum. This causes turbulance and some delivery problems. Replacing these fittings with rounded fittings may improve system efficiency. Cost would have to be determined by a contracts on site estimate. Pay-back period would be difficult to predict.

ENERGY CONSUMPTION

HOUSE #11, KLEINBURG

GAS

BEFORE TUNE-UP

Gas consumed between Jan. 13/82 and Apr. 27/82 = 2114 M^3

= 21871.6 kwh.

Applicable degree days = 1297.6

kwh./degree day = 16.86

Gas consumed between June 29/82 and May 1/83 = 3415 M^3

= 35345.5 kwh.

Applicable degree days = 3534

kwh./degree day = 10.00

AFTER TUNE-UP

Gas consumed between May 13/83 and June 9/83 = 109.6 M^3

= 1134.2 kwh.

Applicable degree day = 71.5

kwh./degree day = 15.9

HOUSE #12

Twenty-two Year Old Maple Sidesplit

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 12 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Split Level

AGE 22 Years

SIZE 116.1 M^2

INSULATION 10 cm in attic. Walls solid masonary.

OCCUPANTS FAMILY SIZE 4

HABITS Leaves thermostat at 21°C and doesn't want to change it.

COMPLAINTS None

FURNACE - TYPE Gas. 29.3 kwh. input, 23.4 kwh. output

AGE 2 years SYSTEM CONDITION Good. Owner did own air balancing. Changed air filter. Adjusted thermostat anticipator.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	74.3%	76%
- NET STACK TEMP. -	135.6°C	126.7°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	76.7°C	72.5°C
" " RISE	50°C	38.8°C
" KILOWATTS	29.9 kwh	21.4 kwh(+2%)
% OF KILOWATTS DEL'D.	52.5%	52.2%
Air Volume DEL'D.	72%	68%

COMMENTS Ducts in basement hidden. As a result of the combustion efficiency improvement, the delivered kwh's. increased by 1.6%.

FUEL RECORD ANALYSIS 1981-82 kwh./degree day = 8.3

FUEL CONSUMPTION IMPROVEMENTS kwh./degree day after tune-up = 4.2.

Gas reduction after tune-up = 49%

RETROFIT OPPORTUNITIES & COSTS

A combustion air intake of the "P" Trap design could be installed in the furnace room. Cost would be $200 - $300, possibly less. Pay back, if any, would have to be determined through further monitoring. It may reduce infiltration through the main floor windows and doors and may improve combustion efficiency.

ENERGY CONSUMPTION

HOUSE #12

GAS

BEFORE TUNE-UP

1981 - 82 4463 M^3 gas used

less 943 M^3 for water heat

= 3435 M^3 for heating

= 35552 kwh.

Applicable degree days = 4301

= 8.3 kwh/degree day

AFTER TUNE-UP

Gas used March 3 to April 24, 1983 = 475 M^3

less 141.6 M^3 for hot water

= 3451 kwh.

Applicable degree days = 823.3

= 4.19 kwh/degree day

HOUSE #13

Brick Bungalow In Maple

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 13 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Brick Bungalow

AGE 24 years

SIZE 102.2 M^2

INSULATION None in wall. R20 in ceiling.

OCCUPANTS FAMILY SIZE 2

HABITS Owner is supply teacher and works irregularly so uses manual set back at night and when away. Normal house temperature is only 15.6°C.

COMPLAINTS None

FURNACE - TYPE Gas. 30.8 kwh. input. 24.6 kwh. output

AGE 2 years SYSTEM CONDITION Excellent. No problem areas.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	77.5%	77.5%
- NET STACK TEMP. -	165.6°C	165.6°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	57.2°C	60°C
" " RISE	39.1°C	39.1°C
" KILOWATTS	23.85 kwh.	23.85 kwh.
% OF KILOWATTS DEL'D.	79.7%*	70%*
Air Volume DEL'D.	102%*	102%*

*These figures are impossible. Unable to determine problem.

COMMENTS This house has a new furnace that was well set up when installed and is well maintained by owner. Tune-up showed no immediate improvements.

FUEL RECORD ANALYSIS Kwh./degree day in 1981-82 = 7.47

Kwh./degree day in 1982-83 = 6.9

Average = 7.18 kwh./degree day

FUEL CONSUMPTION IMPROVEMENTS Kwh./degree day after tune-up = 4.30

Consumption dropped 40% after tune-up.

RETROFIT OPPORTUNITIES & COSTS

There is little that can be done in Phase 2, that would be practical, to improve the efficiency of this system.

ENERGY CONSUMPTION

HOUSE #13

GAS

BEFORE TUNE-UP

Gas consumption from January 6, 1982 to June 1, 1982

= 2294 less 450 M^3 for hot water = 1844 M^3

= 19086 kwh.

Applicable degree day - 2556

= 7.47 kwh./degree day

Gas consumption from September 7, 1982 to March 4, 1983

= 2191 M^3 of gas

less 540 M^3 for water heater = 1741 M^3

= 18019 kwh.

Applicable degree days = 2612

= 6.9 kwh./degree day

AFTER TUNE-UP

March 25 to April 26, 1983 fuel consumption = 296.6 M^3

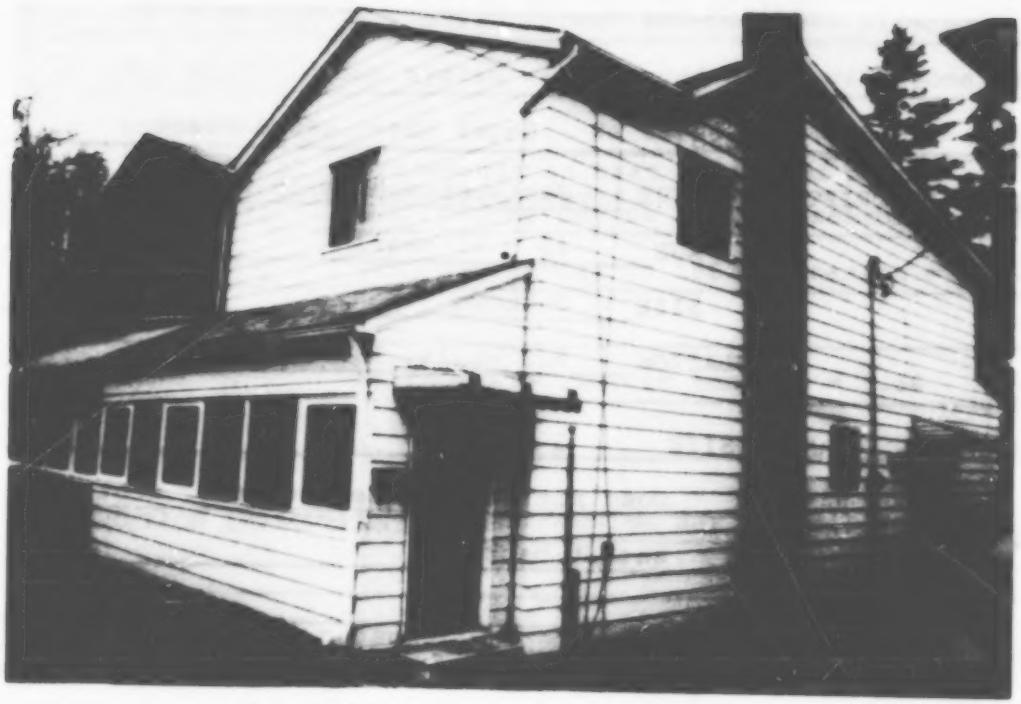
less 106.2 M^3 for water = 190.4 M^3

= 1971 kwh.

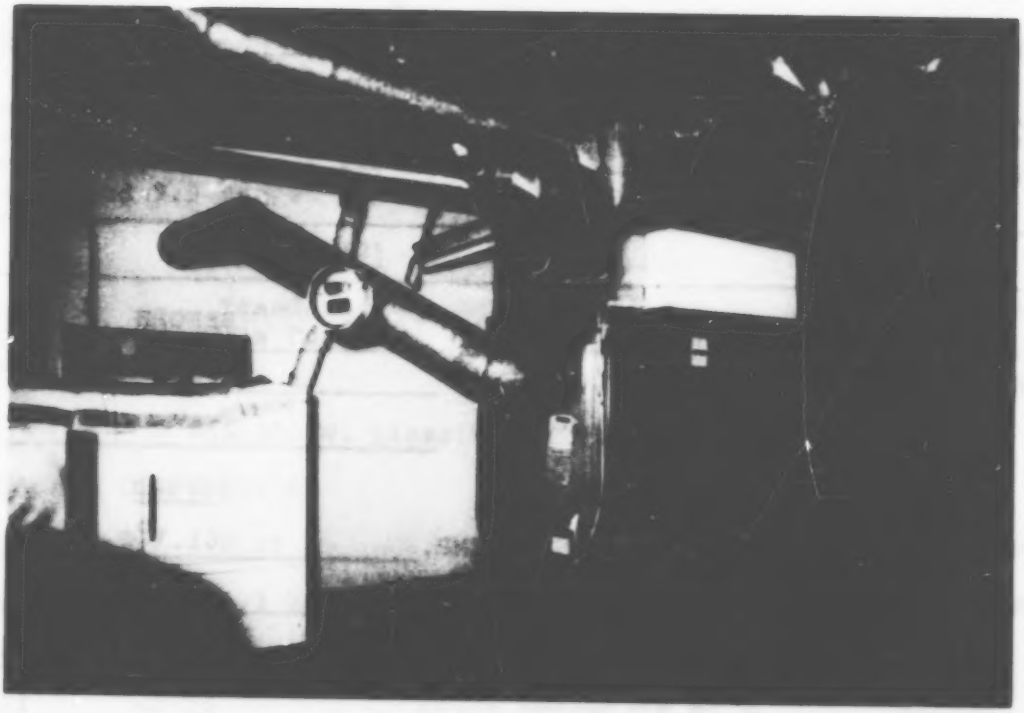
Applicable degree days = 458

= 4.30 kwh./degree day

HOUSE #14



Woodbridge Frame Semi-Detached



Ten Year Old Oil Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 14 ADDRESS Woodbridge

BUILDING DESCRIPTION - TYPE Semi-Detached With Wood Siding

AGE 40 - 50 years

SIZE Unknown

INSULATION R20 Walls, R30 Ceiling

OCCUPANTS FAMILY SIZE 3

HABITS Does not adjust thermostat or want to set it back.

COMPLAINTS The upstairs front bedroom was cool. Adjustment of fan belt, cleaning blower and taping some ducts, delivered more air and heat to all rooms.

FURNACE - TYPE Oil

AGE 10½ years SYSTEM CONDITION Very good condition for age

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	76%	76%
- NET STACK TEMP. -	278°C	278°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	61.1°C	76.7°C
" " RISE	38.5°C	47.9°C
" KILOWATTS	25.8	25.8
% OF KILOWATTS DEL'D.	40.9%	45.6%
Air Volume DEL'D.	46.9%	64.9%

COMMENTS Fan belt adjusted. Reduced fan on-off temperatures to 120°F on and 95°F off. Blower assembly was cleaned. The distribution system was in good shape with some duct connections already taped. We taped some others. Substantial improvements in heat delivered by the distribution, were experienced.

FUEL RECORD ANALYSIS Kwh./degree day in 1981-82 season = 5.54

Kwh./degree day in 1982-83 season = 4.82

Average Kwh. before tune-up = 5.36

FUEL CONSUMPTION IMPROVEMENTS Kwh./degree day - April 6 - 14/83 = 4.96

Fuel consumption reduced by 7.5%

RETROFIT OPPORTUNITIES & COSTS

OPTION (1) PLENUM HEATER

The furnace is in good condition so a plenum heater is a viable option. The cost of installation would be about $1400 less $700 COSP Grant. After tax value of COSP Grant = $490.* Total installed cost = $910. The cost savings would be about $92/year and the pay-back period 9.9 years.

	OPTION (2) Standard Gas Furnace	RECOMMENDED OPTION (3) Med.Effic. (75% Seas.)Gas	OPTION (4) Condensing Gas (90% Seas.)
Cost	$1500(W. Liner)	$1900	$2400
Cost Less COSP	*$975	$1340	$1840
Savings/Year	$155	$ 263	$ 294
Pay-Back	6.3 Years	5.1 Years	6.25 Years

*Assumes 30% tax bracket.

ENERGY CONSUMPTION

HOUSE #14

BEFORE TUNE-UP

1981 - 1982 2203 L. oil = 23,352 kwh.
applicable degree days = 4217
= 5.54 kwh./degree day

1982 - 1983 to Jan. 10 = 634.2 L. oil = 6723kwh.
applicable degree days = 1395
kwh./degree day = 4.82

AFTER TUNE-UP

Oil used between April 6/83 and April 14/83 = 43.5 L.
= 461 kwh.
applicable degree days = 92.9
kwh./degree day = 4.96

HOUSE #14

OPTIONAL ENERGY SOURCES & COSTS

Oil used in 1981 - 1982 = 485 gal. at $1.44/gal. = $698

or = 2203 L. = $698

This equals 23,352 kwh.

Based on a 60% annual efficiency, the kwh. to heat the house would be 14011.2.

OPTION (1) PLENUM HEATER

Cost to heat the house with electricity would be 14,011.20 kwh.

x $.0411/kwh. = $575.86/year

Assuming a plenum heater would reduce the oil consumption by 75%, the annual cost to heat the house with a plenum heater would be as follows:

25% of $698 worth of oil =	$174.50
75% of $575.86 worth of Elect.=	431.90
Total	$606.40
Savings over pure oil =	$ 91.60

OPTION (2)

A standard gas furnace would require 23,352 kwh. input annually. This would require 2273 M^3 of gas. Based on an average month of 227.8 M^3, cost to heat would be $54.41 or .239/$M^3$. Therefore, the annual gas cost is $.239 x 2273 M^3 = $543.25. Savings over oil would be $154.75.

OPTION (3)

A medium efficiency gas furnace with a 75% seasonal efficiency would require 80% of the $543.25 for gas = $434.60. Savings over oil would be $263.40.

...2...

ENERGY CONSUMPTION

HOUSE #14

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1981 - 1982 2203 L. oil = 23,352 kwh.
applicable degree days = 4217
= 5.54 kwh./degree day

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OPTION (3)

A medium efficiency gas furnace with a 75% seasonal efficiency would require 80% of the $543.25 for gas = $434.60. Savings over oil would be $263.40.

...2...

OPTION (4)

A high efficiency gas furnace @ 90% efficiency, will require 2/3 of the gas of regular furnace. An average month may only require 152 M^3 of gas.

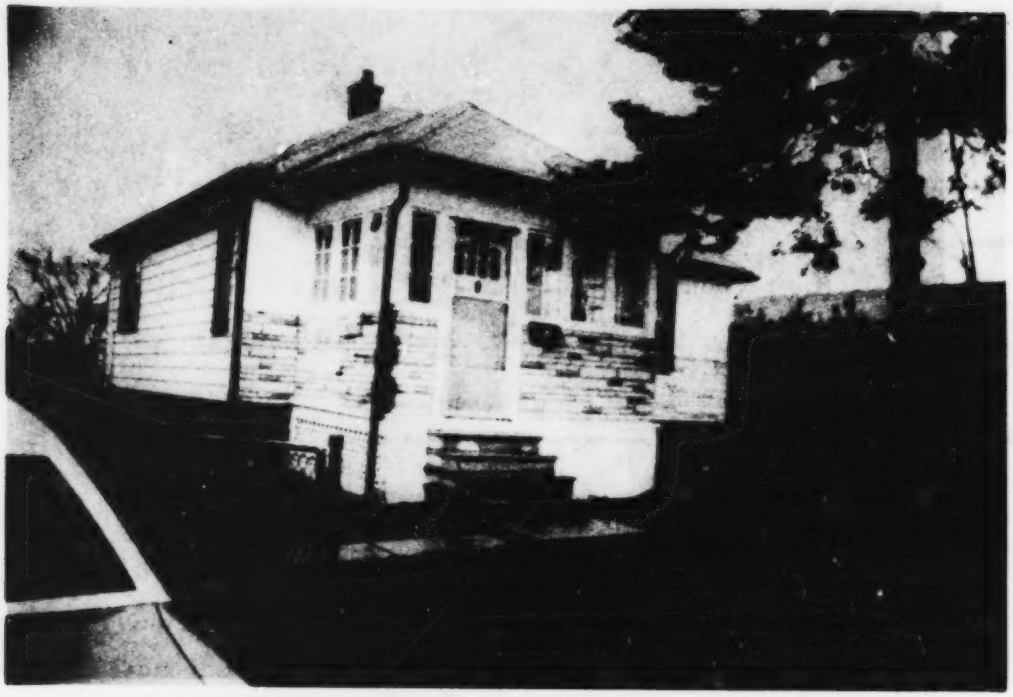
Cost of that gas would be $40.60 or $.267/M3.

Therefore, 2/3 of 2273 M^3 = 1515 M^3

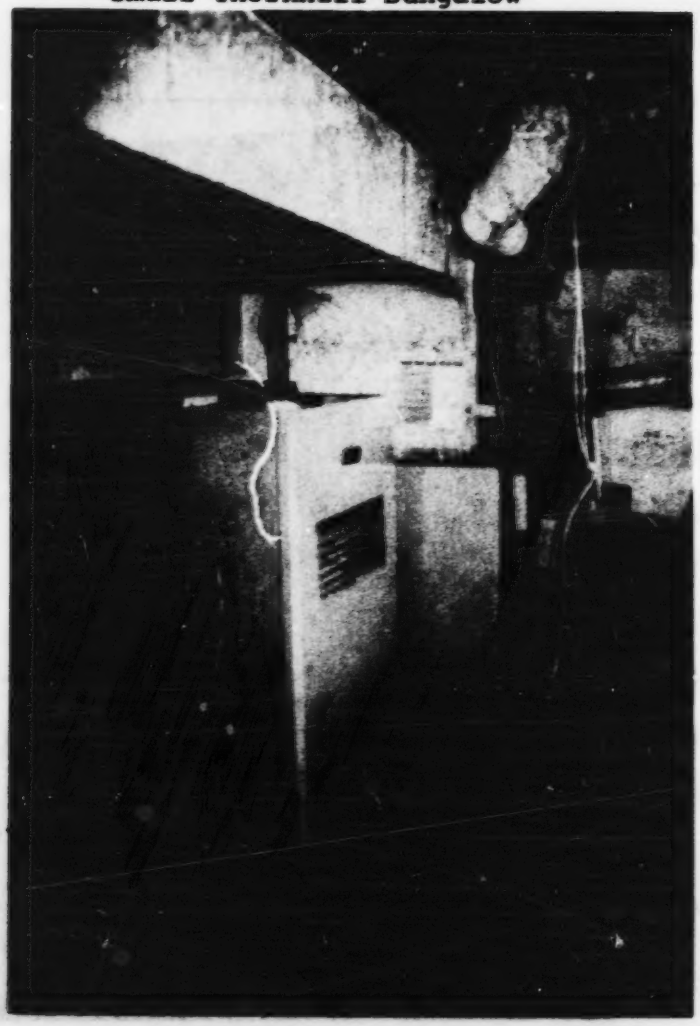
Annual cost = $.267 x 1515 M^3 = 404.50

Savings over oil = $698 - $404.50 = $293.50

HOUSE #15



Small Thornhill Bungalow



Old Oil Furnace And Gas Furnace That W[illegible]l Be Replacing It

HOUSE #15

Unusual Duct Configeration

Furnace Flue Is Badly Corroded

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 15 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Wood frame bungalow

AGE 30 years

SIZE 55.7 M^2

INSULATION None in wall. Ceiling has 25.4 cm. blown in.

OCCUPANTS FAMILY SIZE 2

HABITS Does not set back thermostat.

COMPLAINTS Bathroom is hot but no damper in duct. Duct is corroded. Owner disconnected humidifier.

FURNACE - TYPE Oil. With a .75 Gph nozzle.

AGE Unknown / Very Old SYSTEM CONDITION Poor. Flue is corroded and falling apart. Cracks in combustion chamber. Old duct system design with inside horizontal wall outlets.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	68.1%	74.3%
- NET STACK TEMP. -	303.9°C	300°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	112.8°C	121.1°C
" " RISE	97.1°C	103.8°C
" KILOWATTS	21 kwh.	22.86 kwh. (+8.9%)
% OF KILOWATTS DEL'D.	47%	42.5%
Air Volume DEL'D.	52.5%	47.2%

COMMENTS Though the furnace output and efficiency increased by 8.9%, the system and the furnace could not deliver this increased output through the delivery system.

FUEL RECORD ANALYSIS During the 1982 - 1983 heating season, the average kwh./degree day was 7.18 kwh.

FUEL CONSUMPTION IMPROVEMENTS Not known. Unable to contact occupant to install a new oil flow meter.

RETROFIT OPPORTUNITIES & COSTS

Owner has a used gas furnace that he would like installed this summer.

Oil charges for 1982-83 were $691. Gas would have cost $474 with the conventional gas furnace. Savings would be $217.00/year.

Installation costs would be about $1000 less $350* COSP Grant or $650. Payback would be 3 years.

*Based on 30% tax bracket.

ENERGY CONSUMPTION

HOUSE #15

OIL

BEFORE TUNE-UP

1981 -82 991L - no dates - volume low

1982 - 83 2159.4L oil = 19,490 kwh

applicable deg. day 2713*

= 7.18 kwh./deg. day

* exact dates of consumption unknown

AFTER TUNE-UP

Unable to reach occupant to install new oil meter.

OPTIONAL ENERGY SOURCES & COSTS

HOUSE #15

Oil used during 1982-83 season = 2159 L.

at $.32/L. = $690.88

kwh. = 19,490

Conventional gas furnace equivalent = 1883 M^3

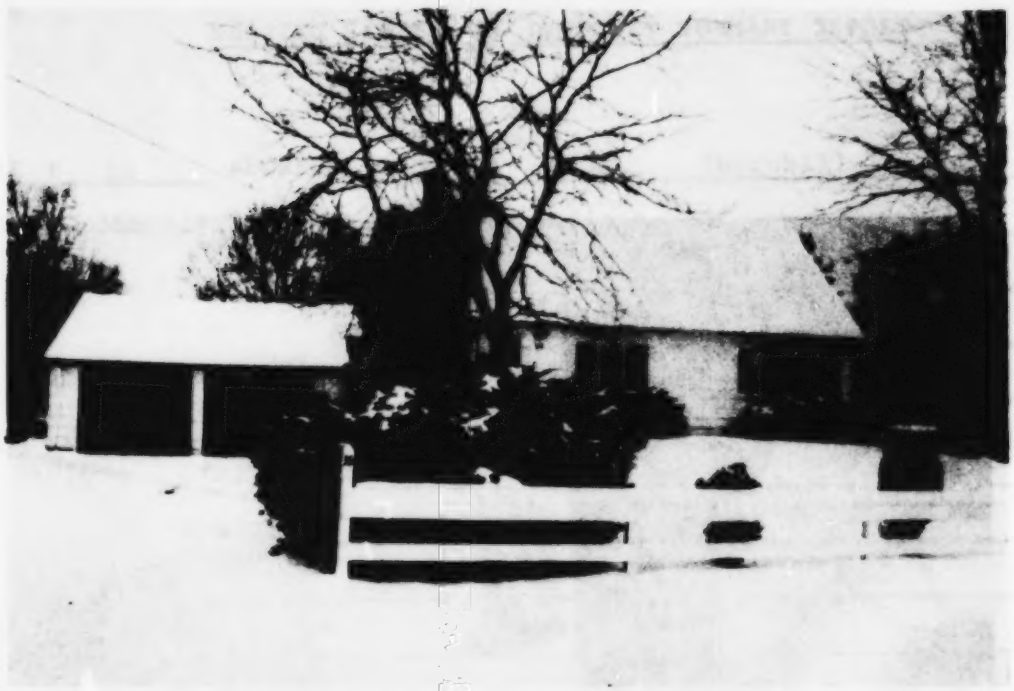
Average month gas consumption = 157 M^3

Cost per average month = $39.52

Annual gas cost = $474.00

Savings over oil = $216.64

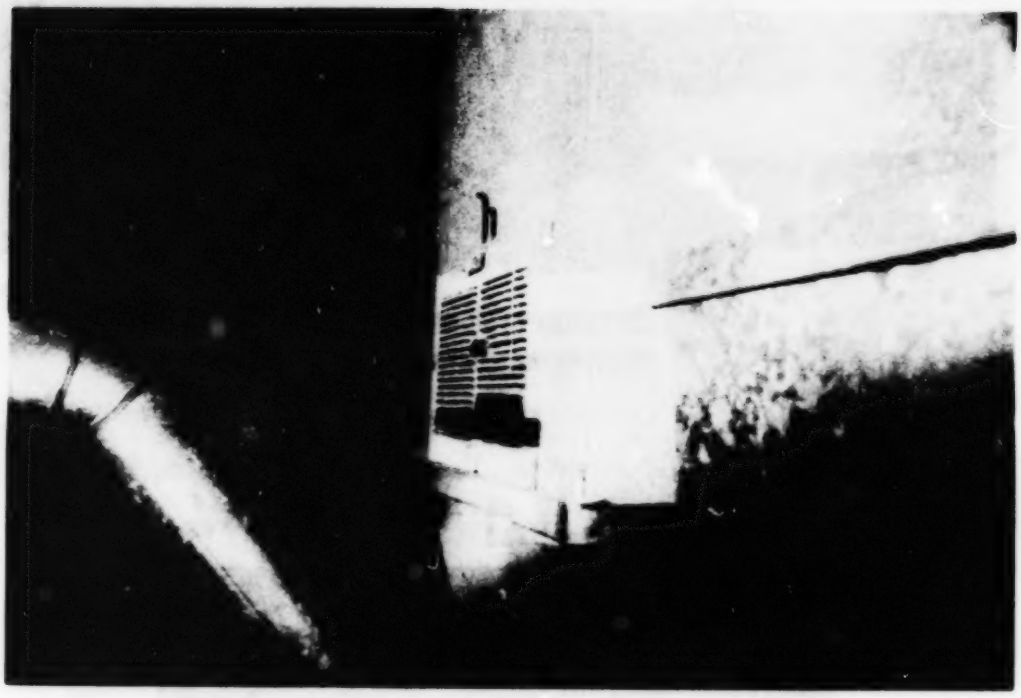
HOUSE #16



Thirty Year Old Storey And One Half
House In Thornhill

Five Year Old
Oil Furnace

HOUSE #16



Return Air Intake Located Too Close To Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 16 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Storey and one half

AGE 30 years

SIZE Unknown

INSULATION Walls none, ceiling none

OCCUPANTS FAMILY SIZE 3

HABITS Varies thermostat with weather

COMPLAINTS Upstairs bedrooms are cool. There is no return air upstairs. Taped some supply air leaks - most ducts concealed. Needs another return air installed near bottom of stairs. Complained of cool drafts. Removal of plastic deflectors eliminated drafts.

FURNACE - TYPE Oil With .75 Gph nozzle

AGE 5 Years SYSTEM CONDITION Lowered fan off/on settings. Return air intake on return air plenum. Tried taping it closed but temperature rise went beyond allowable limits.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	72%	76%
- NET STACK TEMP. -	332.2°C	310°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	76.7°C	71.1°C
" " RISE	53.9°C	46.2°C
" KILOWATTS	22.2 kwh.	23.4 kwh. (+5%)
% OF KILOWATTS DEL'D.	44.3%	44.7%
Air Volume DEL'D	88%	77.7%

COMMENTS Cleaned air filter. Delivered kwhs. increased 5%. Air distribution system improvements would also improve furnace efficiency through the capture of more heat because of total air volume rise.

FUEL RECORD ANALYSIS 1981-1982 average kwh./degree day = 8.72

1982-83 average kwh./degree day = 10.11

Average kwh./degree for both years = 9.24

FUEL CONSUMPTION IMPROVEMENTS Not known at this time as oil meter was defective.

RETROFIT OPPORTUNITIES & COSTS

Option 1 (Recommended) A return air intake could be installed near the bottom of the stairs to the second floor. This would improve the air circulation on both the second and first floors. This change would also improve total system air flow, lowering bonnet temperature and thereby increasing efficiency. Cost is not known, though it would be under $500.

Option 2 Plenum Heater - (Recommended)

The cost of installing a plenum heater would be $1400 less after tax COSP Grant of $490 or $910. The savings would be $134/year, providing a pay back period of 6.8 years.

ENERGY CONSUMPTION

HOUSE #16

OIL

BEFORE TUNE-UP

1981 - 82 3395 L of Oil = 36771 kwh.

Applicable Deg. Days = 4217

= 8.72 kwh/Deg. Days

1982 - 83 2334 L of Oil = 25280 kwh.

Applicable Deg. Days = 2500 (Dates not avail.)

= 10.11 kwh/deg. days

AFTER TUNE-UP

Meter defective

ALTERNATE FUEL COST ANALYSIS FOR HOUSE #16

Oil consumed in one year = 3395L

At a cost of $.32/L. annual fuel cost would be $1086

36771 kwh. of oil burned/year

OPTION (2) If efficiency = 60% then

22063 kwh. of electricity would be required to heat the house.

At $.0411/kwh., cost for one year of electrical heat would be $907.

If a plenum heater reduced oil consumption by 75%, annual fuel cost would be 25% of $1086 & 75% of $907 = $951.75. Therefore, a plenum heater would save $1086-$952 = $134/year.

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 17 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE

AGE 23 Years

SIZE 111.5 M^2

INSULATION None in walls. Unknown amount added to attic

OCCUPANTS FAMILY SIZE 3

HABITS Leaves thermostat at 19°C. Sometimes turns down if going out for the day.

COMPLAINTS Two bedrooms over garage are cool. Kwh. to one was increased by 300% and the other by 68% by air balancing, fan belt adjustment and increased furnace output, because of increase in efficiency.

FURNACE - TYPE Oil with .85 Gph nozzle

AGE 12-23 yrs. SYSTEM CONDITION Anticipator setting needed adjusting. Baffle in furnace is cracked and melting. The 2 year old combustion chamber had come apart and was blocking flame.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	60%	73.8%
- NET STACK TEMP. -	299°C	284°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	62.8°C	72.2°C
" " RISE	41.3°C	47.9°C
" KILOWATTS	20.9 kwh.	25.7 kwh. (+23%)
% OF KILOWATTS DEL'D.	26%	33%
Air Volume DEL'D.	43%	45%

COMMENTS Ducts to rooms over garage pass through unheated and uninsulated space. Furnace output increased by 23%. Total kwh. delivered increased by 55%. Delivered air volume increased by 10.7%. Fan motor noisy and may need new bearings.

FUEL RECORD ANALYSIS 1981 - 1982 kwh./degree day = 7.74

1982 - 1983 kwh./degree day = 7.68

Average = 7.72 kwh./degree day

FUEL CONSUMPTION IMPROVEMENTS No information at this time due to oil flow meter failure.

RETROFIT OPPORTUNITIES & COSTS

The furnace is very old, so a plenum heater or conversion gas burner would be a risky venture, because of the short remaining life span that the furnace may have.

	OPTION (1)	(Recommended) OPTION (2)	OPTION (3)
	Conventional Gas Furnace	Med.Effic. Gas Furnace(75% Seas.)	High Effic. Gas Furnace (95%)
Cost	$1500 W/Liner	$1900	$2400
Cost Less COSP*	$ 975 W/Liner	$1340	$1840
Savings/year	$ 224	$372	$ 444
Pay-back	4.4 Years	3.6 Years	4.1 Years

Electrical options not considered because of the need to upgrade the electrical service to 200 amps. at a relatively high cost.

*Assuming a 30% tax bracket.

ENERGY CONSUMPTION

HOUSE #17

OIL

BEFORE TUNE-UP

1981 - 82 3012.2L oil = 32625 kwh.

Applicable deg. days = 4217

= 7.74 kwh/deg. day

1982 - 83 to February 16, 1983 = 1595.6L = 17282.5 kwh.

Applicable deg. days = 2250.6

= 7.68 kwh/deg. day

AFTER TUNE-UP

No info. meter failure

RETROFIT OPTIONS AND SAVINGS

HOUSE #17

Annual oil consumption = 3012 L. at $.32/L. = $963.84

Annual kwh. = 32625

OPTION (1) CONVENTIONAL GAS FURNACE

M^3 required per year = 3152

Average month gas requirement = 263 M^3

Cost of this gas = $61.68

Annual Cost = $740

Savings over oil = $224/year

OPTION (2) MEDIUM EFFICIENCY GAS FURNACE (75% SEASONAL)

This furnace will use 20% less fuel resulting in a $592 annual gas bill.

Savings over oil = $372/year.

OPTION (3) HIGH EFFICIENCY GAS FURNACE (90% SEASONAL)

This furnace requires 2/3 of the gas of a conventional furnace, or 2100 M^3/year. This results in an average monthly consumption of 175 M^3 or $43.37. Annual cost = $520. Savings over oil = $444 annually.

HOUSE #18

Forty Year Old Brick House

Eleven Year Old Oil Furnace

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 18 ADDRESS Thornhill

BUILDING DESCRIPTION - TYPE Brick storey and one half

AGE 40 years

SIZE Unknown

INSULATION Unknown

OCCUPANTS FAMILY SIZE 2

HABITS Occupants do not set back thermostat and vary its setting frequently

COMPLAINTS Basement recreation room and second floor are cool. Opened outlet in recreation room and upstairs room. Air balanced. Kwh. to recreation room increased by 207%. Kwh. to 2nd. floor increased by 35%.

FURNACE - TYPE Oil. Nozzle was 1.25 Gph. Changed to 1.10 Gph.

AGE 11 years SYSTEM CONDITION Tear in by-pass humidifier duct, taped. A dirty heat exchanger was cleaned. Fir bricks have cracks. Chimney is sooted and their is no clean-out door.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	75.7%	77.4%
- NET STACK TEMP. -	310°C	297.8
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	73.9°C	79.4°C
" " RISE	41.6°C	44.4°C
" KILOWATTS	38.8 kwh.	34.9 kwh.
% OF KILOWATTS DEL'D.	18%	27.6%
air volume DEL'D.	36%	46%

COMMENTS Though bonnet output was reduced 10% by installation of a smaller nozzle, delivered kwhs. increased by 37%. A new oil filter was installed.

FUEL RECORD ANALYSIS 1981-82 kwh./degree day = 16.3
1982-83 kwh./degree day = 16.0

FUEL CONSUMPTION IMPROVEMENTS After tune-up, fuel consumption = 7.8 kwh./degree day. This is a 52% reduction.

RETROFIT OPPORTUNITIES & COSTS

OPTION (1) GAS CONVERSION BURNER - (Recommended)

The cost of a gas conversion burner is $1300, with chimney liner, less COSP Grant or $455* = $845. Savings would be $567/year, providing a pay-back period of 1.5 years.

OPTION (2) PLENUM HEATER

Cost of installing a plenum heater would be $1400 less $490* from the COSP Grant = $910. Annual savings would be $252 providing a 3.6 year pay-back.

*Assumes a 30% tax bracket.

ENERGY CONSUMPTION

HOUSE #18

OIL

BEFORE TUNE-UP

1981 - 82 6346 L. oil = 68736 kwh.

Applicable deg. days = 4217

= 16.3 kwh/deg. day

1982 - 83 3348 L. oil = 36264 kwh.

degree days = 2267.6

= 16.00 kwh/deg. day

AFTER TUNE-UP

April 7, 1983 to May 18, 1983 oil consumption = 366 L.

= 3964 kwh.

Applicable degree days = 509

Kwh/degree day = 7.79

ALTERNATE ENERGY OPTION ANALYSIS FOR HOUSE #18

Annual 1981 consumption = 6346 L.

Cost at $.32/L = $2031

Kwh. = 68736

OPTION (1) GAS CONVERSION BURNER

Gas required annually = 6641 M^3

" " monthly = 553 M^3

Monthly cost = $122

Annual gas cost = $1464

Annual savings = 2031 - 1464 = $567

OPTION (2) PLENUM HEATER

kwh. required/year = 60% of 68736 = 41,242 kwh.

yearly cost = .0411 x 41,242 = $1695

Since a plenum heater will reduce oil consumption by about 75%, annual cost would be:

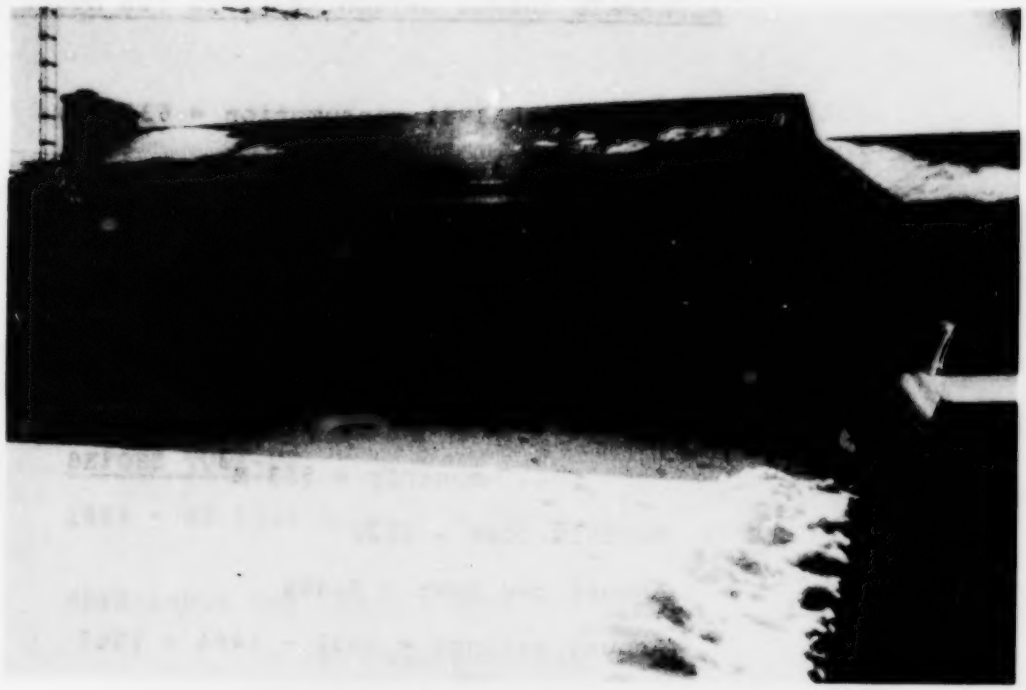
.25 x 2031 =$ 507.75

.75 x 1695 = 1271.25

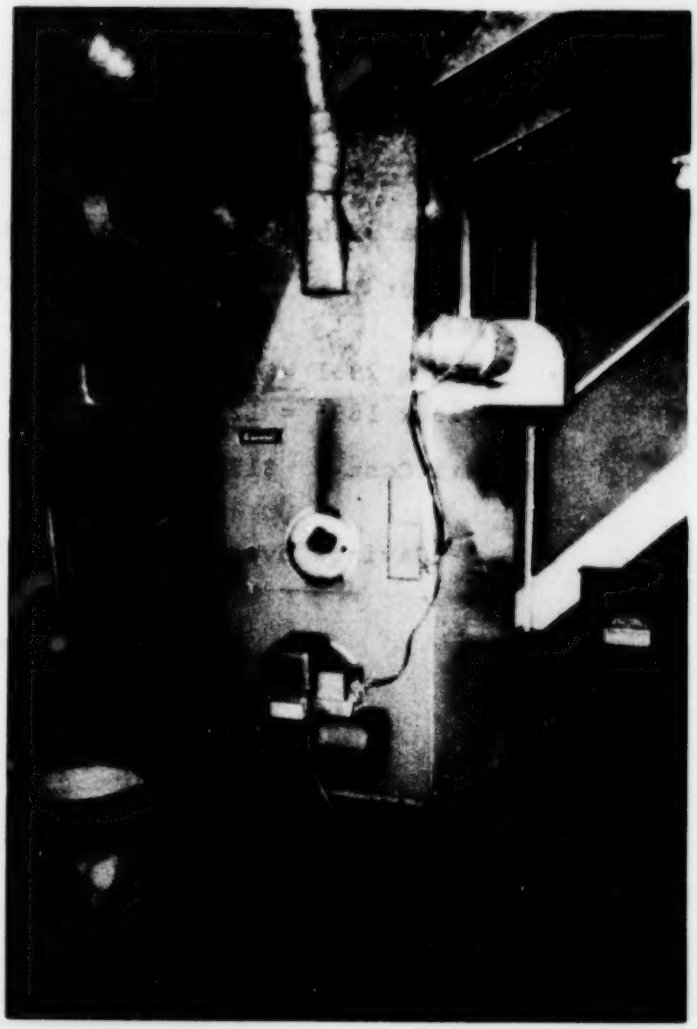
Annual Cost = $1779.00

Savings over oil only = $252

HOUSE #19

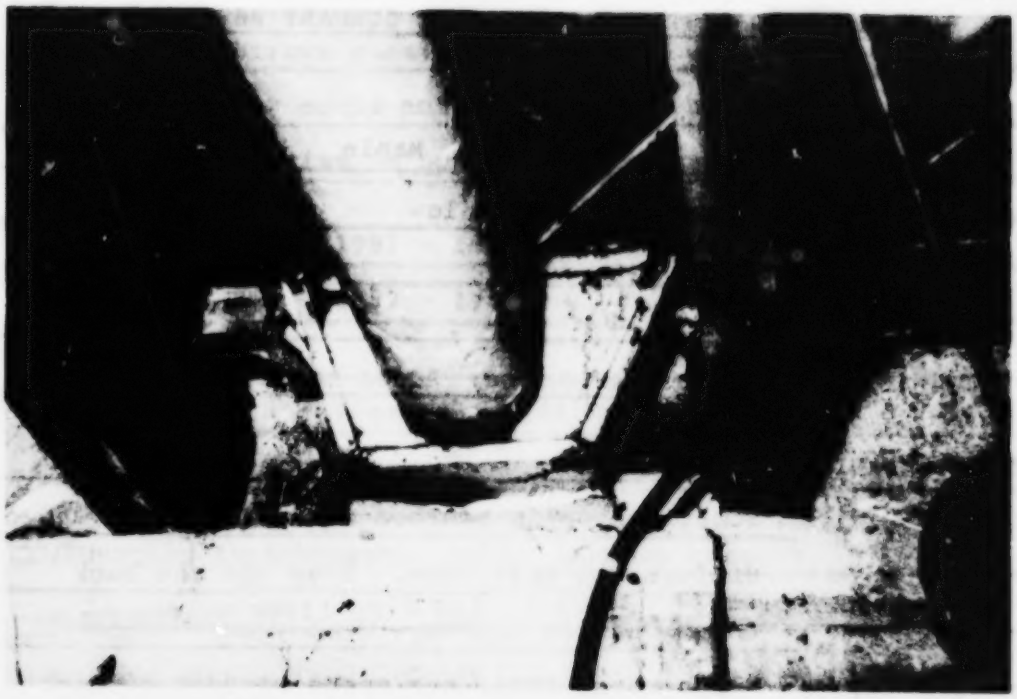


Maple Brick Bungalow

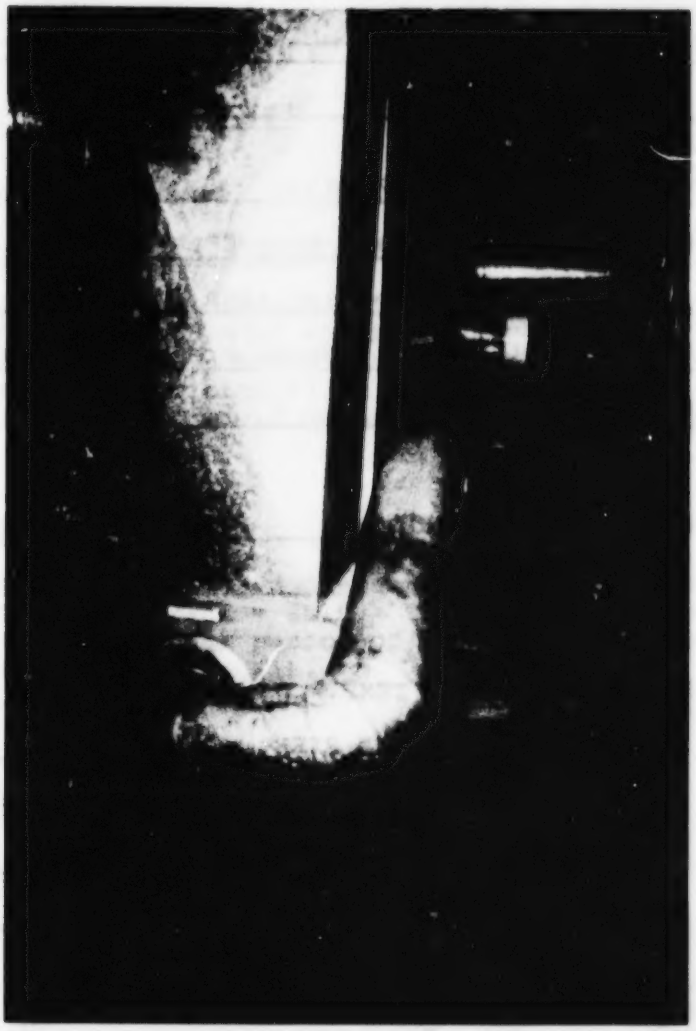


Six Year Old
Oil Furnace

HOUSE #19



Small Boot With Poor Duct Connection



Long Flue Run
To Chimney

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 19 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Brick bungalow

AGE 30 years

SIZE 93 M^2

INSULATION Walls none. Added to ceiling. R value unknown

OCCUPANTS FAMILY SIZE 2

HABITS Sometimes opens bedroom window at night and closes diffuser to that room. Does not set back thermostat at night.

COMPLAINTS North rooms cool, but opens windows at night. House has 4" branch runs. Larger runs could be installed to those rooms that are cool.

FURNACE - TYPE Oil with .75 GPH nozzle

AGE 5-6 years SYSTEM CONDITION Furnace boomed at start-up. Ignition was delayed. Adjusted for instant ignition. Boots are too small. Some back-to-back wall diffusers. These are not very effective.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	78.4%	81%
- NET STACK TEMP. -	245°C	210.6°C
	BEFORE	**AFTER**
DISTRIBUTION TEST RESULTS - BONNET TEMP.	79.4°C	82.2°C
" " RISE	51.1°C	57.7°C
" KILOWATTS	24.13 kwh.	27.24 kwh. (+12.8%)
% OF KILOWATTS DEL'D.	23.8%	21%
Air Volume DEL'D.	35%	35%

COMMENTS The duct system is restricted and poorly designed with all 4" branch runs, so increased output at the bonnet of almost 13% could not be delivered by the distribution system, causing a rise in bonnet temperature.

FUEL RECORD ANALYSIS 1981 - 1982 kwh./degree day = 5.7

1982 - 1983 kwh./degree day = 5.61

Average = 5.66 kwh.

FUEL CONSUMPTION IMPROVEMENTS After tune-up results,

April 12 - May 18/83 kwh./degree days = 4.49

Savings from tune-up = 21%

RETROFIT OPPORTUNITIES & COSTS

Owner does not like natural gas heating.

OPTION (1) HEATING DUCTS - (RECOMMENDED)

The delivery efficiency of this duct system could be greatly improved with the addition of several 5" or 6" branch ducts in place of some of the 4" ducts. New boots would also be required. The cost would have to be estimated on sight by a contractor, however, a substantial improvement could be made for $500. Pay-back period is incalculable.

OPTION (2) PLENUM HEATER

The cost of installing a plenum heater would be about $1400 less $490* after tax COSP Grant = $910. The cost savings would be $55.50/year for a pay-back period of 16.4 years, making this option less desirable than option (1).

*Base on 30% tax bracket.

OPTION (3) Set-Back Thermostat - (Recommended)

The occupants of this house open the bedroom window at night, but have not been lowering their thermostat settings. In such a case, a set-back thermostat may provide some reasonable savings. A digital type thermostat could be installed for $150. If the owner selected a 2.8°C set-back at night, savings would be about $27.00 for a pay-back period of 5.6 years. If the thermostat was set back 5.6°C at night, the savings would be $44.80 annually, providing a 3.3 year pay-back.

ENERGY CONSUMPTION

HOUSE #19

OIL

BEFORE TUNE-UP

Oil consumption between December 16, 1981 and April 7, 1982 = 1389L
= 15044 Kwh.

Applicable degree days = 2638

Kwh./degree days = 5.70

Oil consumption between November 25, 1982 and April 7, 1983 = 1304L
= 14124 kwh.

Applicable degree days = 2517

Kwh./degree days = 5.61

AFTER TUNE-UP

Oil consumption between April 12, 1983 and May 18, 1983 = 185L

This equals 2003.7 kwh.

Applicable degree days = 446

Kwh/degree day = 4.49

HOUSE #19

OPTIONAL ENERGY SOURCES & COSTS

Annual oil consumption = 1400 L.

Cost of annual oil consumption = $.32 x 1400 = $448.

Annual kwh. = 15,163

OPTION (2) PLENUM HEATER

Based on a 60% oil furnace seasonal efficiency, 9098 kwh. of electricity would be required to heat this house.

Annual cost would be $374.

A plenum heater would reduce oil requirements by about 75%. Therefore, costs would be 25% of $448 of oil and 75% of $374 elect. = $392.50

Savings over oil would be $448 - $392.50 = $55.50

OPTION (3) SET-BACK THERMOSTAT

Set-back thermostat - one set-back of 2.8°C = 6% savings or .06 x $448 = $26.80 annually.

One set-back of 5.6°C = 10% savings or .10 x $448 = $44.80 annually.

HEATING SYSTEM AND RETROFIT SUMMARY REPORT

HOUSE # 20 ADDRESS Maple

BUILDING DESCRIPTION - TYPE Brick Bungalow

AGE 28 Years

SIZE 93 M^2

INSULATION None in walls. Added to ceiling twice.

OCCUPANTS FAMILY SIZE One

HABITS Leaves thermostat at 22°C constantly.

COMPLAINTS None

FURNACE - TYPE Gas. 24 kwh. input 21.3 kwh. output

AGE (Inst. June 82) 10 mos. SYSTEM CONDITION Furnace excellent. Duct system had 4" ducts with no dampers.

	BEFORE	AFTER
COMBUSTION TEST RESULTS - EFFICIENCY -	77.5%	77.5
- NET STACK TEMP. -	150.4°C	149.3°C

	BEFORE	AFTER
DISTRIBUTION TEST RESULTS - BONNET TEMP.	62.8°C	62.8°C
" " RISE	37°C	37°C
" KILOWATTS	18.6 kwh.	18.6 kwh
% OF KILOWATTS DEL'D.	15.2%	15.2%
% Air Volume DEL'D.	46.6%	46.6%

COMMENTS This system may work better with large branch ducts. However, in order not to change the air balancing which the owner is happy with, all of the ducts would likely have to be changed --- a rather large project.

FUEL RECORD ANALYSIS Oil - 1981 - 82 Consumption was 11.7 kwh/degree day converted to gas for 82-83 season

FUEL CONSUMPTION IMPROVEMENTS Tune-up was not done until June 10/83, so no immediate monitoring results could be obtained.

RETROFIT OPPORTUNITIES & COSTS

The homeowner leaves the thermostat at one setting so a set-back thermostat would not likely be used. The gas furnace is very new. The duct system could be up-graded, but that would require a complete system, re-design and rebuild.

ENERGY CONSUMPTION

HOUSE #20, MAPLE

OIL

BEFORE TUNE-UP

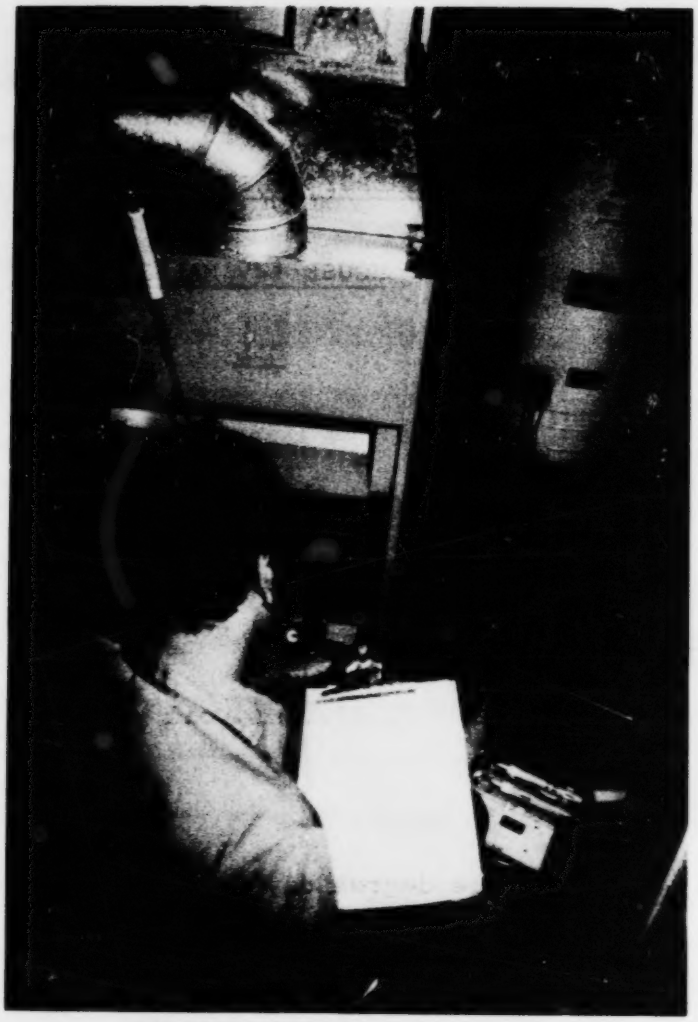
1982 - 83 1,477.5 L. oil = 16,002 kwh.

Applicable degree day = 1,364.7

= 11.7 kwh./degree day

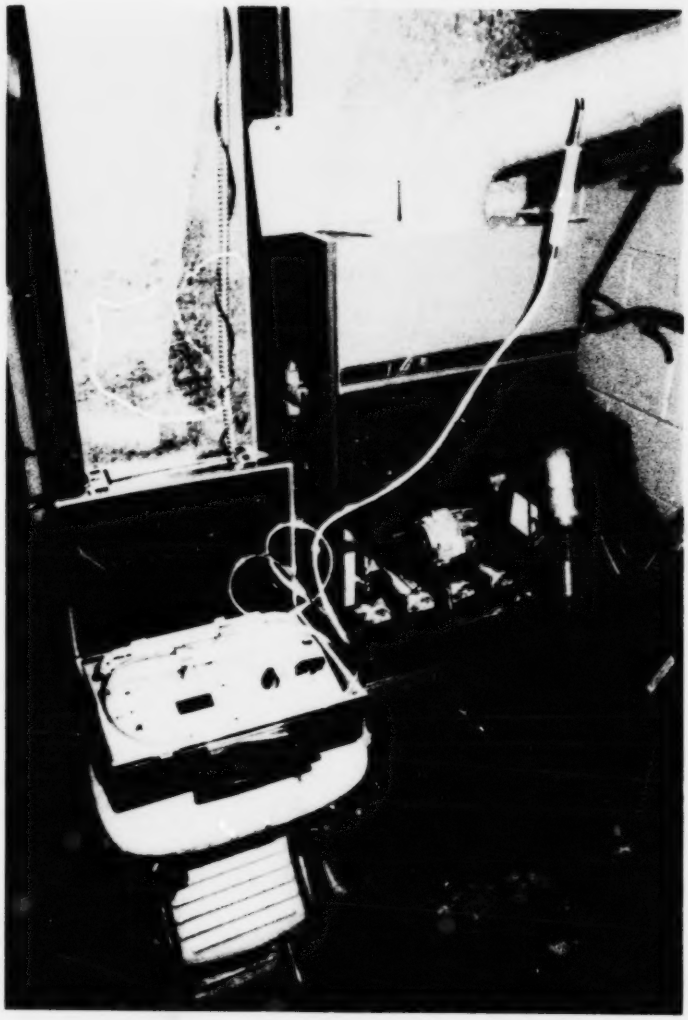
AFTER TUNE-UP

Tune-up not competed until June 10, 1983 because of late sign-up and unavailability of owner; therefore, no immediate monitoring results.



Monitoring The
Furnace Efficiency

Measuring Outlet
Air Volume And
Velocity



Flue Gas Analyzer
In Operation

Checking The Cfm And Heat Output Of a Floor Diffuser

APPENDIX

ACKNOWLEDGEMENTS

Mr. Wade Levy, of Consumers Gas, assisted by providing information on gas consumption, degree/days, and gas availability at some of the sites.

Mr. Bob Bach, President of Atlas Air Conditioning, and Mr. Floyd Murphy, President of L. Villeneuve Ltd., and their staff, provided the expertise and co-operation necessary to do the actual tune-ups.

The following people assisted in the production and editing of the tune-up check lists:

Mr. Bob Bach, Atlas Air Conditioning, Toronto
Mr. Floyd Murphy, L. Villeneuve Ltd., Toronto
Mr. Bill Francis, Francis Fuels, Ottawa
Mr. Ray Robinson, R & R Home Comfort, Breslau
Mr. Frank Dearie, Dearie Contracting, Mississauga

Mr. John Wright and Mr. E. R. Williams, of the Town of Vaughan Building Department, assisted in selecting the test houses.

Mr. Ron Barkley, President R.A.B. DEDESCO Ltd., supplied the electronic flue gas analyzers.

Mr. M. R. Daulman, of Vaughan Hydro, assisted by providing electrical consumption data.

Mr. Ray Wright, of Texaco, provided the oil flow meters.

Make the Most of Your Heating System

Ministry of Municipal Affairs and Housing

Demonstration Project

The Project

In 1981, the Ministry of Municipal Affairs and Housing ran a very successful weatherization demonstration project showing homeowners and industry in 4 cities the importance of caulking and weatherstripping as a first step in conserving energy in the home. This project is intended in a similar way to focus attention on the savings available by concentrating on heating systems.

A "heating system" checklist will be developed which will be appropriate for typical Ontario Homes. The systems will then be tuned and balanced. At the same time, the system will be inspected to determine what other more substantial energy saving measures can be taken.

The project will be conducted in two phases: first, the "tune-up" and follow-up monitoring to determine what savings have been achieved; secondly, provided the homeowner is willing, the more substantial "improvements" will be implemented.

The theme message for the project will be:

"Make the Most of Your Heating System"

Concurrent with the work, the Ministry will carry out a promotional educational campaign to encourage better understanding of the opportunities to increase comfort and reduce energy costs by improving existing heating systems.

Background

Terms of Reference

Previous research carried out by the Ministry (July, 1981), and has established that, virtually all heating systems will perform more effectively with proper maintenance, temperature control and heat distribution. These kinds of improvements can and should be part of most homeowners' attempts to make their homes more comfortable and reduce their fuel costs. This

should also be a part of the service industries easily available maintenance package.

In general, there are 4 approaches to improving heating systems:

1. Regular Servicing

   Regular servicing to replace or clean dirty parts, lubricate the moving parts, check the safety controls and tune the system.

   For example, a thorough cleaning and tuning of an oil system can reduce fuel consumption by as much as 10% on a poorly maintained unit.

2. Getting the Heat Where It's Needed

   In a recent Ministry study, of 10 houses heated with forced air, on the average only 31.7% of the heat which left the furnace got to the heating registers. The range was from 8% to 54%.

   The problem is that Ducts are uninsulated and leaky and much of the heat is spilled in the basement and the walls.

3. Controlling Your Heating System

   Major energy savings are possible by correctly calibrating the thermostat and by having it set low when no one is at home and at night when everyone is asleep. For example, provided the system is balanced, the fuel bill can be lowered by up to 14% by cutting back 5° C (9° F) at these times.

4. Major Alterations

   Major alterations involve the replacement of all or part of existing systems, often "downsizing" existing oil systems or going "off oil" at the same time.

   These are more expensive efforts, but at the same time can lead to substantial savings. Gas for example, is substantially less expensive than oil. As well, newer gas systems are achieving combustion efficiencies 50% higher than many existing systems. Electricity, gas, wood, solar and hybrid combinations are all alternatives that in the right circumstances can lead to substantial savings.

The problem then is four fold.

First, homeowners do not realize that major savings and major improvements in control can be achieved by correct maintenance and improvements to distribution. As well, in certain circumstances more substantial retrofits are appropriate.

Secondly, the furnace service industry, partially due to the absence of consumer demand, is not geared to serve this market. Rather, it is geared to very minor cleaning and tuning or major repairs (in the case of complete malfunction).

Thirdly, homeowners do not realize that there are very simple procedures that they can and should do themselves - caulking and sealing leaky ductwork, turning off pilot lights for the summer, insulating duct runs through colder spaces, using dampers to balance heating systems and so on.

Finally, while the general technical opportunities have been established, there are a number of detailed questions regarding the most appropriate "tune up" packages, what actual savings can be made with different heating systems, what savings result from getting the heat where it's needed and so on.

The Objectives of the Project

The intention of this project is to:

1. answer a series of detailed technical questions in order to better understand what specific measures in what specific circumstances lead to specific savings.

2. in conjunction with industry representatives, to develop basic "tune up" packages which are technically and economically appropriate for general use through the industry.

3. to make homeowners aware of the theme message -

   "Make the Most of Your Heating System"

4. to accelerate the introduction of this new process into the marketplace.

A Description of the Project

The Town of Vaughan, Ontario, has been selected for the project. It is accessible from Toronto, has a mixture of gas, oil and electric systems, and a reasonable mix of media to publicize the project theme - "Make the Most of Your Heating System".

AS well, the Town has an Energy Conservation Co-ordinator on staff and has demonstrated a keen interest in the field of energy conservation.

The Ministry's staff will work closely with the local Municipal and Hydro officials to select test houses which represent a cross section of house types in the community balancing a series of factors such as age, fuel, construction types and so forth. All will be forced air systems.

For Phase I, a "checklist" for heating systems will be developed. Twenty houses will be tested, serviced and tuned and then monitored for the rest of the 82/83 heating season. The reduced fuel savings will be determined by comparing the before and after heating bills after adjusting for different weather conditions (degree days). As a part of this process, the different "improvement" packages will be developed.

In Phase II, more substantial retrofit measures will be undertaken, such as downsizing oil furnaces, sealing leaky ductwork, replacing wrongly sized ductwork and possibly even replacing burners or converting to another fuel source.

The cost of Phase I will be covered by the Ministry. For Phase II, homeowners may be asked to pay part of the costs. The Ministry's contribution, however, is expected to cover all but major replacement or rebuilding jobs. The funding formula will be determined at the commencement of Phase II.

In return for the servicing and improvement of their furnaces, homeowners will agree to allow the Ministry to monitor fuel consumption in their houses. They will also agree not to undertake any major work on their houses during the upcoming heating seasons which might affect the fuel consumption. For Phase II, homeowners' costs above the Ministry's budget ceiling will be voluntary, and if they do not participate, the Ministry will still carry out what work is possible up to the ceiling.

The work will be carried out on behalf of the Ministry by the Heating, Refrigerating and Air Conditioning Institute of Canada, who intend to use the information gathered during the project to further develop the expertise of their members who include most of the heating contractors in Ontario.

The communications aspect of the project will involve promoting the theme message "Make the Most of Your Heating System".

A. <u>Substantial Publicity</u>

- Media Tours, Talk Shows and Newspaper Interviews.
- An opening event with the Mayor, local M.P.P. and Chairman of the Public Utility to demonstrate some of the "do it yourself" possibilities for the media.

B. A Detailed Booklet

- A detailed 28 page booklet reviewing all the heating system opportunities and safety considerations most homeowners should be aware of.

C. Workshops, Project Reports and Results

- During the project, a workshop will be held for municipal employees of the Town of Vaughan, Hydro employees and the general public. If appropriate, a more technical workshop will be held for heating contractors in the area.
- An A.V. show will be prepared and will be made available for showings. Copies of the A.V. show and printed material will be made available to the municipality and the utility.
- At the end of the project when the results have been analysed and the project technical report has been finished, the results will be made available in the community.
- A technical training course will be set up for industry contractors interested in providing this type of service.

Conclusion

In spite of the temporary current glut of oil, home heating costs have clearly reached the point where homeowners must manage their heating systems more efficiently.

If all the heating systems in Ontario were run as efficiently as current technology permits, the use of energy in the residential sector could be reduced by 10% - that's equivalent to 9 million barrels of oil a year - and this calculation excludes the more expensive items such as converting to new non-oil, high efficiency fuel sources.

As well, the increase in comfort made possible by improving distribution systems will make a major difference especially to older residents who despair of feeling comfortable in the Canadian winter.

Ontario's Goals

The Government of Ontario has established the goal of improving the energy efficiency of the average Ontario household 30% from 1980 to 1995 and by 1990 to reduce the use of oil to 10% of the total energy required in the residential sector.

The Ministry of Municipal Affairs and Housing is undertaking a wide range of projects to ensure that the residential sector meets this goal. These include reviewing government regulations such as the building code, research into a wide variety of conservation and renewable energy alternatives, exploring new approaches to municipal planning and making existing housing owned or sponsored by the Ministry more energy efficient. The Ministry of Energy is also doing substantial work in this area.

This project builds on last year's very successful demonstration of the Ministry's weatherize theme:

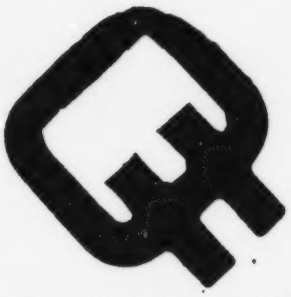
> "First, Seal Your House.....then look at your insulation and heating system"

Informing homeowners and contractors about the potential to improve heating systems is seen as an important part of the effort to meet these goals.

Ministry of Municipal Affairs and Housing

- Research & Development
- Renovation & Energy Conservation Unit
- Communications Branch

with funding from the Ministry of Energy



1983 RATE SCHEDULE

Vaughan Hydro has been advised that the wholesale cost of power purchased from Ontario Hydro will increase on January 1st, 1983, by 8.2%, of which 1.7% will be used to subsidize rural retail customers of Ontario Hydro Costs of materials, labour, and borrowing continue to increase. In addition, changes being made by Ontario Hydro in billing to Vaughan Hydro make it imperative that this Commission achieve a substantial improvement in its financial position. The Commission has adopted a rate of increase of 5.7% average, which, subject to approval by Ontario Hydro, will effect all energy use on and after January 1st, 1983. The new rate schedule is as follows:

RESIDENTIAL

Up to 250 KWH per month	7.2 ¢ per KWH
Additional use	4.11¢ per KWH
Minimum bill	$4.00 per month

GENERAL SERVICE - REGULAR

Demand charges - first 50 KW per month	No charge
- additional demand	$3.05 per KW per month

ENERGY

Up to 250 KWH per month	7.2 ¢ per month
Next 9,750 KWH per month	4.61¢ per month
Next 180,000 KWH per month	3.10¢ per month
Additional use	1.94¢ per month

GENERAL SERVICE - INTERMEDIATE USER

(over 500 KW damand per month)

Demand Charges - all KW	$7.45 per KW per month
Energy Charges - all KWH	1.94¢/KWH
Flat Rate Water Heating	Schedule 227
Sentinel Lighting	$15.63 per KW per month
Water Heater Rentals - 40 gal tank	$2.50 plus retail sales tax
- 60 gal tank	$3.25 plus retail sales tax
- 100 gal. tank	$6.00 plus retail sales tax

VAUGHAN HYDRO-ELECTRIC COMMISSION

P.O. BOX 697, MAPLE, ONTARIO L0J 1E0

PHONE: 669-9890

Chairman
C. J. Graham

Vice-Chairman
L. J. Reesor

Commissioner
W. A. Cox

Commissioner
Mayor L. D. Jackson

FINAL

TUNE-UP

CHECK LISTS

ENERGY SAVER

ELECTRIC FURNACE TUNE-UP

CHECK LIST

Homeowner's Name _____

Address _____ Work Order # _____

Phone: Res. _____ Bus. _____ Date Of Visit _____ By ____

Time Arrived _____ Time Out _____

Thermostat A Check Location OK ☐ BAD ☐
B Type _____

Check anticipator and adjust as necessary
Adjusted YES ☐ NO ☐

Comments _____

Brief Shell Check Age of House _____ Fireplace Present YES ☐ NO ☐

Windows - Type - _____ Opens _____ Closed _____

Doors - _____ Insulation Levels _____

Brief Distribution System Check

Check Outlets And Return Air - Sufficient? Yes ☐ No ☐

Comments _____

_____

Homeowner Comfort Problems _____

_____

_____ Water Heater Fuel? _____

Visual Check Of Distribution System And Duct Layout Okay ☐ Bad ☐

Note Any Deficiencies _____

A/C System Present? Yes ☐ No ☐ Humidifier Type? _____

Furnace Make _____ Model _____

Check electrical elements and sequencers.

_____

Turn Up Thermostat

ELECTRIC FURNACE CHECK LIST

Check and adjust fan switch setting, if necessary.
(95°F Off, 120°F On) What was setting? On_____,Off_____

On Continuous Run Yes ☐ No ☐ 2 Speed Motor Yes ☐ No ☐

Bonnett Temperature_____Temp. Rise_____

System CFM_____($\frac{\text{Bonnet Btuh or Kwh.}}{\text{Temp. Rise x 1.1}}$)

Blower Assembly - Inspect - Clean? Moderate? Dirty?

Clean, if necessary and indicate._____

Check and adjust fan belt and pulley and indicate corrections.

_____

_____AMP Draw on motor?_____

Change or clean filter, if necessary and indicate_____

Distribution System - Balance to satisfy customer complaints.

Comments - _____

_____

_____

Tape any badly leaking ducts and indicate, if required.

If basement overheated, close down outlets and tape more duct connections as required.

New Bonnet Temperature_____Temp. Rise_____

System CFM = _____% Improvement In Dist. System CFM = _____

Lower thermostat to original setting_____

Suggested Improvements & Approximate Costs

_____

_____

_____

_____

_____

_____

_____

_____

ENERGY SAVER

GAS FURNACE TUNE-UP

CHECK LIST

Homeowner's Name _____

Address _____ W/O# _____

Phone: Res. _____ Bus. _____ Date Of Visit _____ By ____

Time Arrived _____ Time Out _____

Thermostat A Check Location - OK ☐ BAD ☐
B Type _____

Check Anticipator And Adjust If Necessary
Adjusted- Yes ☐ No ☐

Comments _____

Brief Shell Check- Age Of House? _____ Fireplace present? Y ☐ N ☐

Windows - Type _____ Opens? _____ Closed? _____

Doors - _____ Insulation Levels _____

Brief Distribution System Check

Check Outlets And Return Air - Sufficient? Yes ☐ No ☐

Comments _____

_____

Homeowner Comfort Problems _____

_____

_____ Water Heater Fuel? _____

Visual Check Of Distribution System And Duct Layout Okay ☐ Bad ☐

Note Any Deficiencies _____

A/C System? Yes ☐ No ☐ Humidifier? _____ Type? _____

Furnace Make _____ Model _____

Input Rating _____ Output _____

Turn up Thermostat

First Furnace Efficiency Test - CO^2 ___% Room Temp. _____ Stack Temp. ____

GAS FURNACE CHECK LIST

Net Stack Temp._____ Efficiency_____%

Bonnett Temperature_____Temp. Rise_____

Bonnet Btuh_____ Bonnet Cfm_____

Heat Exchanger Condition (A) Clean (B) Moderate (C) Dirty

Clean Heat Exchanger If Condition "B" Or "C" Exists.

Check Combustion Chamber Conditions. Good_____ Poor_____

Comments_____

Check Gas Manifold Pressure And Adjust Using Gas Meter Input.

Initial Manifold Pressure_____Metered Input_____

Final Manifold Pressure_____Metered Input_____

Check And Adjust Fan Control Setting, If Necessary.

(95°F Off, 120°F On) Initial Setting On_____Off_____

Set For Continuous Run Yes ☐ No ☐ Two Speed Motor? Yes ☐ No ☐

Turn Off Main Switch

Blower Assembly - Inspect - Clean? Average? Dirty?

Clean, If Necessary And Indicate _____

Blower Size_____

Check And Adjust Fan Belt And Pulley And Indicate Corrections

_____

Amp Draw?_____If Direct Drive Rpm?_____

Change Or Clean Filter, If Necessary - _____

Turn On Main Switch

Chimney - Type? - Masonry - Tile Liner Yes No
No Liner Yes No
Metal Liner Yes No
Manufactured-Type A Yes No
Type B Yes No
Other - indicate_____

Condition And Recommendations?_____

_____

Distribution System - If Possible, Balance To Satisfy Customer Complaints

GAS FURNACE CHECK LIST

Comments _____

_____

Tape Any Badly Leaking Ducts And Indicate, If Required _____

If Basement Overheated, Close Down Outlets And Tape Duct Connections as required to stop leaks.

Repeat Furnace Efficiency Test

CO^2 _____ % Room Temp. _____ Stack Temp. _____

Net Stack Temp. _____ Efficiency _____

New Bonnet Temp. _____ Temp. Rise _____

New Bonnet Btuh _____ % Improvement _____

New System Cfm _____ % Improvement _____

Check limit switch OK? Faulty?

Check other safety devices. Comments _____

Is There Sufficient Combustion Air? Yes ☐ No ☐

Lower Thermostat To Original setting.

SUGGESTED IMPROVEMENTS & ESTIMATED COST

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

ENERGY SAVER

OIL FURNACE TUNE-UP

CHECK LIST

Homeowner's Name _____

Address _____ W/O # _____

Phone: Res. _____ Bus. _____ Date Of Visit _____ /By ___

Time Arrived _____ Time Out _____

Thermostat A Check Location OK ☐ BAD ☐
B Type _____

Check Anticipator & Adjust If Necessary. Adjusted? Yes ☐ No ☐

Comments _____

Brief Shell Check - Age Of House? _____ Fireplace Present? Yes ☐ No ☐

Windows - Type _____ Opens? _____ Closed? _____

Doors - _____ Insulation Levels? _____

Brief Distribution System Check

Check Outlets And Return Air - Sufficient? Yes ☐ No ☐
Comments _____

_____

Homeowner Comfort Problems _____

_____

_____ Water Heater Fuel? _____

Visual Check Of Distribution System And Duct Layout Okay ☐ Bad ☐

Note Deficiencies _____

A/C System? Yes ☐ No ☐ Humidifier? Yes ☐ No ☐ Type?

Chimney - Type - Masonry? Tile Lined Yes ☐ No ☐
No Liner Yes ☐ No ☐
Metal Liner Yes ☐ No ☐
Manufactured? Type A Yes ☐ No ☐
Other - Indicate _____

State Condition & Recommendations _____

_____

_____

OIL FURNACE CHECK LIST

Furnace Make_____ Model_____

Input Rating_____ Nozzle Shown On Name Plate - Size / Type / Spay Angle

Complete Combustion Test (1) First

PREPARING FOR COMBUSTION TEST #2

1. Check oil filter.
2. Shut off main burner switch.
3. Inspect and clean out accumulated soot in heat and combustion chamber.
4. Check and adjust draft regulator for smooth operation.
5. Advance thermostat. (5-10°F)
6. Remote control burner switch on.
7. Make ¼" diameter hole in flue pipe and overfire (for test instruments)
8. Insert thermometer (200-1000°F range) through ½" diameter hole in flue pipe.
9. Inspect and adjust flame with flame mirror.
10. Turn on main burner switch. (starting burner)

*Test (1) is conducted before any work is completed.
*Test (2) is conducted after all tune-up procedures have been completed.

COMBUSTION TEST PROCEDURE & INSPECTION DATA

		Test(1)	Test(2)
(1) Flame Ignition	Instant		
	Delayed		
	No Ignition		
(2) Flame Colour (If flame in 2 colours check both)	Orange		
	Yellow		
	White		
	Sparks		
(3) Flame Shape	Uniform		
	Lop-Sided		
(4) Flame Impingement	At Bottom		
	At Sides		
	At Rear		
(5) Soot Deposit	Flue		
	Comb.Chamber		
(6) Over Fire Draft In W.C.			

	Test(1)	Test
(7) Flue Gas Temp.		
(8) Basement Air Temp.		
(9) Net Stack Temp. (7-8)		
(10) Flue Draft in. of W.C.		
(11) % C.O.2		
(12) Smoke Reading #		
(13) % Combustion Efficiency		
(14) Oil Pressure (PSI)		
(15) Nozzle-Size		
Type		
Spray Angle		

Heat Exchanger Condition - (A) Clean (B) Average (C) Dirty

Clean Heat Exchanger If (B) or (C) Exists. Cleaned_____, Not Req.'d._____

OIL FURNACE CHECK LIST

Check Combustion Chamber Condition - Good?_____Poor?_____Type_____

Comments_____

Bonnet Temperature_____Temp. Rise_____

Bonnet Btuh_____Bonnet Cfm_____

Check And Adjust Fan Control Setting, If necessary (95°F off, 120° on)

Is it set on continuous run? Yes☐ No☐ 2 Speed Motor Yes☐ No☐

Initial Setting? On_____Off_____

Turn Off Main Switch

Blower Assembly - Inspect. Clean?_____Average?_____Dirty?_____

" " Size _____Amp. Draw_____

Clean, If Necessary And Indicate - Cleaned _____, Not Required_____

Direct Drive? Yes☐ No☐

Check And Adjust Fan Belt And Pulley And Indicate Corrections.

_____

Change Or Clean Filter, If Necessary_____

Turn On Main Switch

Distribution System - If Possible, Balance To Satisfy Customer Complaints If Required.

Comments -_____

_____

_____

Tape Badly Leaking Ducts And Indicate, If Required_____

If Basement Still Overheated After Balancing, Tape More Duct Joints.

Complete Combustion Test (2) And Record

New Bonnet Temperature_____Temp. Rise_____

New Bonnet Btuh?_____% Improvement_____

New System Cfm._____% Improvement_____

Is there sufficient combustion air? Yes☐ No☐

Combustion Air? OK☐ Insufficient☐ _____

OIL FURNACE CHECK LIST

Check Relay Safety Lockout _____ Seconds On?

Check Limit Switch OK ☐ Replace ☐

Lower Thermostat To Original Setting

SUGGESTED IMPROVEMENTS & ESTIMATED COSTS

POOR

QUALITY

ORIGINAL